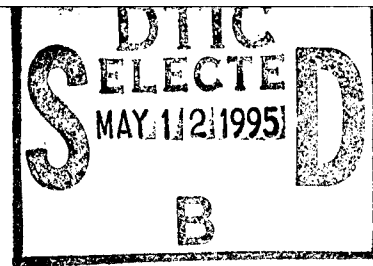




# The Department of Defense



## DoD DEPARTMENTS:



Department  
of the Army



Department  
of the Navy



Department  
of the  
Air Force

DECLASSIFICATION STATEMENT A

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Distribution Unlimited

**PROGRAM SOLICITATION 95.2**  
**CLOSING DATE: 14 APRIL 1995**

**FY 1995  
SMALL BUSINESS  
INNOVATION  
RESEARCH (SBIR)  
PROGRAM**

19950511 061

## PROGRAM SOLICITATION

Number 95.2

Small Business  
Innovation  
Research Program

Accession For	
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DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
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### IMPORTANT

The DoD is updating its SBIR Mailing list. To remain on the mailing list or to be added to the list, send in the Mailing List form (Reference E), found at the back of this solicitation, to DTIC. Failure to send the form will result in no future mailings of the DoD SBIR Program Solicitation to your address.

U.S. Department of Defense  
SBIR Program Office  
Washington, DC 20301

Closing Date: April 14, 1995

Deadline for receipt of  
proposals at the DoD  
Component is 2:00 p.m.  
local time.

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# DoD PROGRAM SOLICITATION FOR SMALL BUSINESS INNOVATION RESEARCH

## 1.0 PROGRAM DESCRIPTION

### 1.1 Introduction

The Army, Navy and Air Force hereafter referred to as DoD Components acting on behalf of the Office of Technology Transition in the Office of the Director, Defense Research and Engineering, invite small business firms to submit proposals under this program solicitation entitled Small Business Innovation Research (SBIR). Firms with strong research and development capabilities in science or engineering in any of the topic areas described in Section 8.0 and with the ability to commercialize the results are encouraged to participate. Subject to availability of funds, DoD Components will support high quality research and development proposals of innovative concepts to solve the listed defense-related scientific or engineering problems, especially those concepts that also have high potential for commercialization in the private sector.

Objectives of the DoD SBIR Program include stimulating technological innovation, strengthening the role of small business in meeting DoD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research and development results.

The Federal SBIR Program is mandated by Public Laws PL 97-219, PL 99-443, and PL 102-564. The basic design of the DoD SBIR Program is in accordance with the Small Business Administration (SBA) SBIR Policy Directive, January 1993. The DoD Program presented in this solicitation strives to encourage technology transfer with a focus on advanced development projects with a high probability of commercialization success, both in the government and private sector. The guidelines presented in this solicitation incorporate and exploit the flexibility of the SBA Policy Directive to encourage proposals based on scientific and technical approaches most likely to yield results important to DoD and the private sector.

### 1.2 Three Phase Program

This program solicitation is issued pursuant to the Small Business Innovation Development Act of 1982, PL 97-219, PL 99-443, and PL 102-564. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas submitted under the SBIR Program and will typically be one half-person year effort over a period not to exceed six months. Proposals should concentrate on that research and development which will significantly contribute to proving the scientific and

technical feasibility of the proposed effort, the successful completion of which is a prerequisite for further DoD support in Phase II. The measure of Phase I success includes evaluations of the extent to which Phase II results would have the potential to yield a product or process of continuing importance to DoD and the private sector. Proposers are encouraged to consider whether the research and development they are proposing to DoD Components also has private sector potential, either for the proposed application or as a base for other applications. If it appears to have such potential, proposers are encouraged, on an optional basis, to obtain a contingent commitment for private follow-on funding to pursue further development of the commercial potential after the government funded research and development phases.

Subsequent Phase II awards will be made to firms on the basis of results from the Phase I effort and the scientific and technical merit of the Phase II proposal. Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months (subject to negotiation). Phase II is the principal research and development effort and is expected to produce a well-defined deliverable product or process. A more comprehensive proposal will be required for Phase II.

Under Phase III, the small business is expected to use non-federal capital to pursue private sector applications of the research development. Also, under Phase III, federal agencies may award non-SBIR funded follow-on contracts for products or processes which meet the mission needs of those agencies. This solicitation is designed, in part, to encourage the conversion of federally sponsored research and development innovation into private sector applications. The federal research and development can serve as both a technical and pre-venture capital base for ideas which may have commercial potential.

*This solicitation is for Phase I proposals only.* Any proposal submitted under prior SBIR solicitations will not be considered under this solicitation; however, offerors who were not awarded a contract in response to a particular topic under prior SBIR solicitations are free to update or modify and submit the same or modified proposal if it is responsive to any of the topics listed in Section 8.0.

For Phase II, no separate solicitation will be issued and no unsolicited proposals will be accepted. Only those firms that were awarded Phase I contracts will be considered (Section 4.3 and 5.2).

DoD is not obligated to make any awards under either Phase I, II, or III. DoD is not responsible for any monies expended by the proposer before award of any contract.

### 1.3 Follow-On Funding

In addition to supporting scientific and engineering research and development, another important goal of the program is conversion of DoD-supported research and development into commercial products. Proposers are encouraged to obtain a contingent commitment for private follow-on funding prior to Phase II where it is felt that the research and development has commercial potential in the private sector.

Proposers who feel that their research and development have the potential to meet private sector market needs, in addition to meeting DoD objectives, are encouraged to obtain non-federal follow-on funding for Phase III to pursue private sector development. The commitment should be obtained during the course of Phase I performance. This commitment may be contingent upon the DoD supported development meeting some specific technical objectives in Phase II which if met, would justify non-federal funding to pursue further development for commercial purposes in Phase III. *Note that when several Phase II proposals receive evaluations being of approximately equal merit, proposals that demonstrate such a commitment for follow-on funding will receive extra consideration during the evaluation process.*

The recipient will be permitted to obtain commercial rights to any invention made in either Phase I or Phase II, subject to the patent policies as stated in Section 5.7.

### 1.4 Eligibility and Limitation

Each proposer must qualify as a small business for research and development purposes as defined in Section 2.0 and certify to this on the Cover Sheet (Appendix A) of the proposal. In addition, a minimum of two-thirds of each Phase I SBIR project must be carried out by the proposing firm. For Phase II, a minimum of one-half of the effort must be performed by the proposing firm. For both Phase I and II, the primary employment of the principal investigator must be with the small business firm at the time of the award and during the conduct of the proposed effort. Primary employment means that more than one-half of the principal investigator's time is spent with the small business. Deviations from these requirements must be approved in writing by the contracting officer (during contract negotiations).

For both Phase I and Phase II, the research and development work must be performed by the small business concern in the United States. "United States" means the fifty states, the Territories and possessions of the United States, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, and the District of Columbia.

Joint ventures and limited partnerships are permitted, provided that the entity created qualifies as a small business

in accordance with the Small Business Act, 15 USC 631, and the definition included in Section 2.2.

### 1.5 Conflicts of Interest

Awards made to firms owned by or employing current or previous Federal Government employees could create conflicts of interest for those employees in violation of 18 USC and 10 USC 2397. Such proposers should contact the cognizant Ethics Counsellor of the DoD Component for further guidance.

### 1.6 Contact with DoD

**a. General Information.** General information questions pertaining to proposal instructions contained in this solicitation should be directed to:

Mr. Bob Wrenn  
SBIR Coordinator  
U.S. Department of Defense  
OSD/SADBU - The Pentagon, Room 2A340  
Washington, DC 20301-3061  
(703) 697-1481

Other non-technical questions pertaining to a specific DoD Component should be directed to the point of contact listed in each topic in Section 8.0 of this solicitation. Oral communications with DoD Components regarding the technical content of this solicitation during the Phase I proposal preparation periods are prohibited for reasons of competitive fairness.

**b. Requests for Copies of DoD SBIR Solicitation.**  
To remain on the DoD SBIR Mailing list, send in the Mailing List form (Reference E) to DTIC. Additional copies of this solicitation may be ordered from:

Defense Technical Information Center  
Attn: DTIC/SBIR  
Building 5, Cameron Station  
Alexandria, Virginia 22304-6415  
(800) 363-7247 (800 DOD-SBIR)  
(703) 274-6903 commercial

This solicitation is also available on floppy diskette (in Word Perfect) from DTIC for a nominal processing fee. See Section 7.1 for information about Internet access to the solicitation at DTIC.

The DoD SBIR solicitation can be obtained electronically using Business Gold, the National Technology Transfer Center's bulletin board system. Connect via Internet by telneting to iron.nttc.edu, or by dialing (304) 243-2560 for high speed modems (9600+) or (304) 243-2561 for 1200-2400 baud modems and logging in as guest. For more information on the NTTC electronic

bulletin board system contact:

National Technology Transfer Center  
Wheeling Jesuit College  
316 Washington Ave  
Wheeling, WV 26003  
(800) 678-6882

**c. Outreach Program.** The DoD holds three National SBIR Conferences a year and participates in many state-organized conferences for small business. We have a special outreach effort to socially and economically and disadvantaged firms and to small companies that are negatively affected by the Defense down-sizing.

## 2.0 DEFINITIONS

The following definitions apply for the purposes of this solicitation:

### 2.1 Research and Development

**Basic Research** - Scientific study and experimentation to provide fundamental knowledge required for the solution of problems.

**Exploratory Development** - A study, investigation or minor development effort directed toward specific problem areas with a view toward developing and evaluating the feasibility and practicability of proposed solutions.

**Advanced Development** - Proof of design efforts directed toward projects that have moved into the development of hardware for test.

**Engineering Development** - Full-scale engineering development projects for DoD use but which have not yet received approval for production.

### 2.2 Small Business

A small business concern is one that, at the time of award of a Phase I or Phase II contract:

a. Is independently owned and operated and organized for profit, is not dominant in the field of operation in which it is proposing, and has its principal place of business located in the United States;

b. Is at least 51% owned, or in the case of a publicly owned business, at least 51% of its voting stock is owned by United States citizens or lawfully admitted permanent resident aliens;

c. Has, including its affiliates, a number of employees not exceeding 500, and meets the other regulatory requirements found in 13 CFR 121. Business concerns, other than investment companies licensed, or state development companies qualifying under the Small Business Investment Act of 1958, 15 USC 661, et seq., are affiliates of one another when either directly or indirectly (1) one concern controls or has the power to control the other; or (2) a third party or parties controls or has the power to control both. Control can be exercised through common ownership, common management, and contractual

relationships. The term "affiliates" is defined in greater detail in 13 CFR 121.3-2(a). The term "number of employees" is defined in 13 CFR 121.3-2(t). Business concerns include, but are not limited to, any individual, partnership, corporation, joint venture, association or cooperative.

### 2.3 Socially and Economically Disadvantaged Small Business

A small business that is at the time of award of a Phase I or Phase II contract:

a. At least 51% owned by an Indian tribe or a native Hawaiian organization, or one or more socially and economically disadvantaged individuals, and

b. Whose management and daily business operations are controlled by one or more socially and economically disadvantaged individuals.

A socially and economically disadvantaged individual is defined as a member of any of the following groups: Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Subcontinent-Asian Americans, or other groups designated by SBA to be socially disadvantaged.

### 2.4 Women-Owned Small Business

A women-owned small business is one that is at least 51% owned by a woman or women who also control and operate it. "Control" in this context means exercising the power to make policy decisions. "Operate" in this context means being actively involved in the day-to-day management.

### 2.5 Funding Agreement

Any contract, grant, or cooperative agreement entered into between any federal agency and any small business concern for the performance of experimental, developmental, or research work funded in whole or in part by the federal government. *Only the contract method will be used by DoD components for all SBIR awards.*

## 2.6 Subcontract

A subcontract is any agreement, other than one involving an employer-employee relationship, entered into by a Federal Government contract awardee calling for supplies or services required solely for the performance of the original contract. This includes consultants.

## 2.7 Commercialization

The process of developing markets and producing and delivering products for sale (whether by the originating party or by others); as used here, commercialization includes both government and private sector markets.

# 3.0 PROPOSAL PREPARATION INSTRUCTIONS AND REQUIREMENTS

## 3.1 Proposal Requirements

A proposal to any DoD Component under the SBIR Program is to provide sufficient information to persuade the DoD Component that the proposed work represents an innovative approach to the investigation of an important scientific or engineering problem and is worthy of support under the stated criteria.

The quality of the scientific or technical content of the proposal will be the principal basis upon which proposals will be evaluated. The proposed research and development must be responsive to the chosen topic. Any small business contemplating a bid for work on any specific topic should determine that (a) the technical approach has a reasonable chance of meeting the topic objective, (b) this approach is innovative, not routine, and (c) the firm has the capability to implement the technical approach, i.e. has or can obtain people and equipment suitable to the task.

Those responding to this solicitation should note the proposal preparation tips listed below:

- Read and follow all instructions contained in this solicitation.
- Use the free technical information services from DTIC and other information assistance organizations (Section 7.1 - 7.4).
- Mark proprietary information as instructed in Section 5.5.
- Limit your proposal to 25 pages (excluding company commercialization report).
- Use a type size no smaller than 12 pitch or 11 point.
- Don't include proprietary or classified information in the project summary (Appendix B).
- Include a Red Copy of Appendix A and Appendix B as part of the Original of each proposal.
- Do not use a proportionally spaced font on Appendix A and Appendix B.
- Include a company commercialization report listing all SBIR Phase I and Phase II projects and the commercialization status of Phase II projects (see Section 3.4.n).

## 3.2 Proprietary Information

If information is provided which constitutes a trade secret, proprietary, commercial or financial information, confidential personal information, or data affecting the national security, it will be treated in confidence to the extent permitted by law, provided it is clearly marked in accordance with Section 5.5.

## 3.3 Limitations on Length of Proposal

This solicitation is designed to reduce the investment of time and cost to small firms in preparing a formal proposal. Those who wish to respond must submit a direct, concise, and informative research and development proposal of no more than 25 pages, excluding commercialization record summary, (no type smaller than 11 point or 12 pitch on standard 8½" X 11" paper with one (1) inch margins, 6 lines per inch), *including Proposal Cover Sheet (Appendix A), Project Summary (Appendix B), Cost Proposal (Appendix C), and any enclosures or attachments.* Promotional and non-project related discussion is discouraged. Cover all items listed below in Section 3.4 in the order given. The space allocated to each will depend on the problem chosen and the principal investigator's approach. In the interest of equity, proposals in excess of the 25-page limitation (including attachments, appendices, or references, but excluding commercialization record summary) will not be considered for review or award.

## 3.4 Phase I Proposal Format

All pages shall be consecutively numbered and the ORIGINAL of each proposal must contain a completed red copy of Appendix A and Appendix B.

a. **Cover Sheet.** Complete RED COPY of Appendix A, photocopy the completed form, and use a copy as Page 1 of each additional copy of your proposal.

b. **Project Summary.** Complete RED COPY of Appendix B, photocopy the completed form, and use a copy as Page 2 of each additional copy of your proposal.



The technical abstract should include a brief description of the project objectives and description of the effort. Anticipated benefits and commercial applications of the proposed research and development should also be summarized in the space provided. The Project Summary of successful proposals will be submitted for publication with unlimited distribution and, therefore, will not contain proprietary or classified information.

**c. Identification and Significance of the Problem or Opportunity.** Define the specific technical problem or opportunity addressed and its importance. (Begin on Page 3 of your proposal.)

**d. Phase I Technical Objectives.** Enumerate the specific objectives of the Phase I work, including the questions it will try to answer to determine the feasibility of the proposed approach.

**e. Phase I Work Plan.** Provide an explicit, detailed description of the Phase I approach. The plan should indicate what is planned, how and where the work will be carried out, a schedule of major events, and the final product to be delivered. Phase I effort should attempt to determine the technical feasibility of the proposed concept. The methods planned to achieve each objective or task should be discussed explicitly and in detail. This section should be a substantial portion of the total proposal.

**f. Related Work.** Describe significant activities directly related to the proposed effort, including any conducted by the principal investigator, the proposing firm, consultants, or others. Describe how these activities interface with the proposed project and discuss any planned coordination with outside sources. The proposal must persuade reviewers of the proposer's awareness of the state-of-the-art in the specific topic.

Describe previous work not directly related to the proposed effort but similar. Provide the following: (1) short description, (2) client for which work was performed (including individual to be contacted and phone number), and (3) date of completion.

**g. Relationship with Future Research and Development.**

- (1) State the anticipated results of the proposed approach if the project is successful.
- (2) Discuss the significance of the Phase I effort in providing a foundation for Phase II research and development effort.

**h. Potential Post Applications.** Describe:

- (1) Whether and by what means the proposed project appears to have potential use by the Federal Government.
- (2) Whether and by what means the proposed project

appears to have potential private sector application.

**i. Key Personnel.** Identify key personnel who will be involved in the Phase I effort including information on directly related education and experience. A concise resume of the principal investigator, including a list of relevant publications (if any), must be included.

**j. Facilities/Equipment.** Describe available instrumentation and physical facilities necessary to carry out the Phase I effort. Items of equipment to be purchased (as detailed in Appendix C) shall be justified under this section. Also state whether or not the facilities where the proposed work will be performed meet environmental laws and regulations of federal, state (name) and local governments for, but not limited to, the following groupings: airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

**k. Consultants.** Involvement of university or other consultants in the project may be appropriate. If such involvement is intended, it should be described in detail and identified in Appendix C. A minimum of two-thirds of each Phase I SBIR project must be carried out by the proposing firm, unless otherwise approved in writing by the contracting officer.

**l. Prior, Current, or Pending Support.** If a proposal submitted in response to this solicitation is substantially the same as another proposal that has been funded, is now being funded, or is pending with another federal agency or DoD Component or the same DoD Component, the proposer must indicate action on Appendix A and provide the following information:

- (1) Name and address of the federal agency(s) or DoD Component to which a proposal was submitted, will be submitted, or from which an award is expected or has been received.
- (2) Date of proposal submission or date of award.
- (3) Title of proposal.
- (4) Name and title of principal investigator for each proposal submitted or award received.
- (5) Title, number, and date of solicitation(s) under which the proposal was submitted, will be submitted, or under which award is expected or has been received.
- (6) If award was received, state contract number.
- (7) Specify the applicable topics for each SBIR proposal submitted or award received.

*Note: If Section 3.4.1 does not apply, state in the proposal "No prior, current, or pending support for proposed work."*

**m. Cost Proposal.** Complete the cost proposal in the form of Appendix C for the Phase I effort only. Some

items of Appendix C may not apply to the proposed project. If such is the case, there is no need to provide information on each and every item. What matters is that enough information be provided to allow the DoD Component to understand how the proposer plans to use the requested funds if the contract is awarded.

- (1) List all key personnel by name as well as by number of hours dedicated to the project as direct labor.
- (2) Special tooling and test equipment and material cost may be included under Phases I and II. The inclusion of equipment and material will be carefully reviewed relative to need and appropriateness for the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the government and should be related directly to the specific topic. These may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the government or acquired with government funds will be vested with the DoD Component, unless it is determined that transfer of title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.
- (3) Cost for travel funds must be justified and related to the needs of the project.
- (4) Cost sharing is permitted for proposals under this solicitation; however, cost sharing is not required nor will it be an evaluation factor in the consideration of a proposal.

## 4.0 METHOD OF SELECTION AND EVALUATION CRITERIA

### 4.1 Introduction

Phase I proposals will be evaluated on a competitive basis and will be considered to be binding for six (6) months from the date of closing of this solicitation unless offeror states otherwise. If selection has not been made prior to the proposal's expiration date, offerors will be requested as to whether or not they want to extend their proposal for an additional period of time. Proposals meeting stated solicitation requirements will be evaluated by scientists or engineers knowledgeable in the topic area. Proposals will be evaluated first on their relevance to the chosen topic. Those found to be relevant will then be evaluated using the criteria listed in Section 4.2. Final decisions will be made by the DoD Component based upon these criteria and consideration of other factors including possible duplication of other work, and program balance. A DoD Component may elect to fund several or none of the proposed approaches to the same topic. In the evaluation and handling of proposals, every effort will be made to protect the confidentiality of the proposal and any

n. **Company Commercialization Report of Prior SBIR Awards.** For Phase I proposals, if the small business concern has received more than 15 Phase II awards in the prior 5 fiscal years, it must submit a Company Commercialization Report that lists the name of awarding agency, date of award, contract number, topic or subtopic, title, and award amount for each Phase I and Phase II project, and commercialization status for each Phase II. All Phase II proposals must include a Company Commercialization Report. (This required proposal information shall not be counted toward proposal page count limitations.)

### 3.5 Bindings

Do not use special bindings or cover. Staple the pages in the upper left hand corner of each proposal.

### 3.6 Phase II Proposal

This solicitation is for Phase I only. A Phase II proposal can be submitted only by a Phase I awardee and only in response to a request from the agency; that is, Phase II is not initiated by a solicitation. Each proposal must contain a Red Cover Sheet (Appendix A), a Red Project Summary Sheet (Appendix B), and a Company Commercialization Report (see Section 3.4.n) regardless of the number of Phase II awards received. Copies of Appendices along with instructions regarding Phase II proposal preparation and submission will be provided by the DoD Components to all Phase I winners at time of Phase I contract award.

evaluations. There is no commitment by the DoD Components to make any awards on any topic, to make a specific number of awards or to be responsible for any monies expended by the proposer before award of a contract.

For proposals that have been selected for contract award, a Government Contracting Officer will draw up an appropriate contract to be signed by both parties before work begins. Any negotiations that may be necessary will be conducted between the offeror and the Government Contracting Officer. It should be noted that only a duly appointed contracting officer has the authority to enter into a contract on behalf of the U.S. Government.

Phase II proposals will be subject to a technical review process similar to Phase I. Final decisions will be made by the Office of the Secretary of Defense and the DoD Components based upon the scientific and technical evaluations and other factors, including a commitment for Phase III follow-on funding, the possible duplication with other research and development, program balance, budget limitations, and the potential of a successful Phase II effort

leading to a product of continuing interest to DoD.

Upon written request and after final award decisions have been announced, a debriefing will be provided to unsuccessful offerors on their proposals.

#### 4.2 Evaluation Criteria - Phase I

The DoD Components plan to select for award those proposals offering the best value to the government and the nation considering the following factors.

- a. The soundness and technical merit of the proposed approach and its incremental progress toward topic or subtopic solution
- b. The potential for commercial (government or private sector) application and the benefits expected to accrue from this commercialization
- c. The adequacy of the proposed effort for the fulfillment of requirements of the research topic
- d. The qualifications of the proposed principal/key investigators supporting staff and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.

Where technical evaluations are essentially equal in merit, cost to the government will be considered in determining the successful offeror.

Technical reviewers will base their conclusions only on information contained in the proposal. It cannot be assumed that reviewers are acquainted with the firm or key individuals or any referenced experiments. Relevant supporting data such as journal articles, literature, including government publications, etc., should be contained or referenced in the proposal.

#### 4.3 Evaluation Criteria - Phase II

The Phase II proposal will be reviewed for overall merit based upon the criteria below.

- a. The soundness and technical merit of the proposed approach and its incremental progress toward topic or subtopic solution

- b. The potential for commercial (government or private sector) application and the benefits expected to accrue from this commercialization
- c. The adequacy of the proposed effort for the fulfillment of requirements of the research topic
- d. The qualifications of the proposed principal/key investigators supporting staff and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.

The reasonableness of the proposed costs of the effort to be performed will be examined to determine those proposals that offer the best value to the government. Where technical evaluations are essentially equal in merit, cost to the government will be considered in determining the successful offeror.

The follow-on funding commitment must provide that a specific amount of Phase III funds will be made available to or by the small business and indicate the dates the funds will be made available. It must also contain specific technical objectives which, if achieved in Phase II, will make the commitment exercisable by the small business. The terms cannot be contingent upon the obtaining of a patent due to the length of time this process requires. The funding commitment shall be submitted with the Phase II proposal.

Phase II proposal evaluation may include on-site evaluations of the Phase I effort by government personnel.

#### 4.4 Assessing Commercial Potential of Proposals

A Phase I or Phase II proposal's commercial potential can be evidenced by:

- (1) the small business concern's record of commercializing SBIR or other research (see Company Commercialization Report, Section 3.4.n),
- (2) the existence of second phase funding commitments from private sector or non-SBIR funding sources,
- (3) the existence of third phase follow-on commitments for the subject of the research, or
- (4) the presence of other indicators of commercial potential of the idea.

## 5.0 CONTRACTUAL CONSIDERATIONS

Note: Eligibility and Limitation Requirements (Section 1.4) Will Be Enforced

#### 5.1 Awards (Phase I)

a. **Number of Phase I Awards.** The number of Phase I awards will be consistent with the agency's RDT&E budget, the number of anticipated awards for interim Phase I modifications, and the number of anticipated Phase II contracts. No Phase I contracts will be

awarded until all qualified proposals (received in accordance with Section 6.2) on a specific topic have been evaluated. All proposers will be notified of selection/non-selection status for a Phase I award no later than September 15, 1995. The name of those firms selected for awards will be announced. *The DoD Components anticipate making 40 Phase I awards from this solicitation.*

**b. Type of Funding Agreement.** All winning proposals will be funded under negotiated contracts and may include a fee or profit. The firm fixed price or cost plus fixed fee type contract will be used for all Phase I projects (see Section 5.4). *Note: The firm fixed price contract is the preferred type for Phase I.*

**c. Average Dollar Value of Awards.** DoD Components will make Phase I awards to small businesses typically on a one-half person-year effort over a period generally not to exceed six months (subject to negotiation). PL 102-564 allows agencies to award Phase I contracts up to \$100,000 without justification.

## 5.2 Awards (Phase II)

**a. Number of Phase II Awards.** The number of Phase II awards will depend upon the results of the Phase I efforts and the availability of funds. *The DoD Components anticipate that approximately 40 percent of its Phase I awards will result in Phase II projects.*

**b. Type of Funding Agreement.** Each Phase II proposal selected for award will be funded under a negotiated contract and may include a fee or profit.

**c. Project Continuity.** Phase II proposers who wish to maintain project continuity must submit proposals no later than 30 days prior to the expiration date of the Phase I contract and must identify in their proposal the work to be performed for the first four months of the Phase II effort and the costs associated therewith. *These Phase II proposers may be issued a modification to the Phase I contract, at the discretion of the government,* covering an interim period not to exceed four months for preliminary Phase II work while the total Phase II proposal is being evaluated and a contract is negotiated. This modification would normally become effective at the completion of Phase I or as soon thereafter as possible. Funding, scope of work, and length of performance for this interim period will be subject to negotiations. Issuance of a contract modification for the interim period does not commit the government to award a Phase II contract.

**d. Average Dollar Value of Awards.** Phase II awards will be made to small businesses based on results of the Phase I efforts and the scientific, technical, and commercial merit of the Phase II proposal. Average Phase II awards will typically cover 2 to 5 person-years of effort over a period generally not to exceed 24 months (subject to negotiation). PL 102-564 states that the Phase II awards may be up to \$750,000 each without justification.

## 5.3 Reports

**a. Content.** A final report is required for each Phase

I project. The report must contain in detail the project objectives, work performed, results obtained, and estimates of technical feasibility. A completed SF 298, "Report Documentation Page", will be used as the first page of the report. In addition, Monthly status and progress reports may be required by the DoD agency. (A Sample SF 298 is provided in Reference D.)

### **b. Preparation.**

- (1) To avoid duplication of effort, language used to report Phase I progress in a Phase II proposal, if submitted, may be used verbatim in the final report with changes to accommodate results after Phase II proposal submission and modifications required to integrate the final report into a self-contained comprehensive and logically structured document.
- (2) Block 12a (Distribution/Availability Statement) of the SF298, "Report Documentation Page" in each unclassified final report must contain one of the following statements:
  - (a) Distribution authorized to U.S. Government Agencies only; report contains proprietary data produced under SBIR contract. Other requests shall be referred to the performing organization in Block 7 of this form.
  - (b) Approved for public release; SBIR report, distribution unlimited.
- (3) The report abstract (Block 13 of the SF 298, "Report Documentation Page") must identify the purpose of the work and briefly describe the work carried out, the finding or results and the potential applications of the effort. Since the abstract may be published by the DoD, it must not contain any proprietary or classified data.

**c. Submission.** SIX COPIES of the final report on each Phase I project shall be submitted within the DoD in accordance with the negotiated delivery schedule. Delivery will normally be within thirty days after completion of the Phase I technical effort. One copy of each unclassified report shall be delivered directly to the DTIC, ATTN: Document Acquisition, Cameron Station, Alexandria, VA 22304-6145.

## 5.4 Payment Schedule

The specific payment schedule (including payment amounts) for each contract will be incorporated into the contract upon completion of negotiations between the DoD and the successful Phase I or Phase II offeror. Successful offerors may be paid periodically as work progresses in accordance with the negotiated price and payment schedule. Phase I contracts are primarily fixed price contracts, under which monthly progress payments may be made up to 90% of the contract price excluding fee or profit. The contract may include a separate provision for payment of a fee or

profit. Final payment will follow completion of contract performance and acceptance of all work required under the contract. Other types of financial assistance may be available under the contract.

### **5.5 Markings of Proprietary or Classified Proposal Information**

The proposal submitted in response to this solicitation may contain technical and other data which the proposer does not want disclosed to the public or used by the government for any purpose other than proposal evaluation.

Information contained in unsuccessful proposals will remain the property of the proposer except for Appendices A and B. The government may, however, retain copies of all proposals. Public release of information in any proposal submitted will be subject to existing statutory and regulatory requirements.

If proprietary information is provided by a proposer in a proposal which constitutes a trade secret, proprietary commercial or financial information, confidential personal information or data affecting the national security, it will be treated in confidence, to the extent permitted by law, provided this information is clearly marked by the proposer with the term "confidential proprietary information" and provided that the following legend which appears on the title page (Appendix A) of the proposal is completed:

"For any purpose other than to evaluate the proposal, this data except Appendix A and B shall not be disclosed outside the government and shall not be duplicated, used, or disclosed in whole or in part, provided that if a contract is awarded to the proposer as a result of or in connection with the submission of this data, the government shall have the right to duplicate, use or disclose the data to the extent provided in the contract. This restriction does not limit the government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained in page(s) \_\_\_\_\_ of this proposal."

Any other legend may be unacceptable to the government and may constitute grounds for removing the proposal from further consideration and without assuming any liability for inadvertent disclosure. The government will limit dissemination of properly marked information to within official channels.

In addition, each page of the proposal containing proprietary data which the proposer wishes to restrict must be marked with the following legend:

"Use or disclosure of the proposal data on lines specifically identified by asterisk (\*) are subject to the restriction on the cover page of this proposal."

The government assumes no liability for disclosure or use of unmarked data and may use or disclose such data for any purpose.

In the event properly marked data contained in a proposal in response to this solicitation is requested pursuant to the Freedom of Information Act, 5 USC 552, the proposer will be advised of such request and prior to such release of information will be requested to expeditiously submit to the DoD Component a detailed listing of all information in the proposal which the proposer believes to be exempt from disclosure under the Act. Such action and cooperation on the part of the proposer will ensure that any information released by the DoD Component pursuant to the Act is properly determined.

Those proposers that have a classified facility clearance may submit classified material with their proposal. Any classified material shall be marked and handled in accordance with applicable regulations. Arbitrary and unwarranted use of this restriction is discouraged. Offerors must follow the Industrial Security Manual for Safeguarding Classified Information (DoD 5220.22M) procedures for marking and handling classified material.

### **5.6 Copyrights**

To the extent permitted by statute, the awardee may copyright (consistent with appropriate national security considerations, if any) material developed with DoD support. DoD receives a royalty-free license for the Federal Government and requires that each publication contain an appropriate acknowledgement and disclaimer statement.

### **5.7 Patents**

Small business firms normally may retain the principal worldwide patent rights to any invention developed with government support. The government receives a royalty-free license for its use, reserves the right to require the patent holder to license others in certain limited circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must normally manufacture it domestically. To the extent authorized by 35 USC 205, the government will not make public any information disclosing a government-supported invention for a period of four years to allow the awardee to pursue a patent.

### **5.8 Technical Data Rights**

Rights in technical data, including software, developed under the terms of any contract resulting from proposals submitted in response to this solicitation shall remain with the contractor, except that the government shall have the limited right to use such data for government purposes and

shall not release such data outside the government without permission of the contractor for a period of four years from completion of the project from which the data was generated unless the data has already been released to the general public. However, effective at the conclusion of the four-year period, the government shall retain a royalty-free license for government use of any technical data delivered under an SBIR contract whether patented or not. See FAR clause 52.227-20, "Rights in Data - SBIR Program" and DFARS 252-227-7013 alternate II(3) "Government Purpose License Rights".

### 5.9 Cost Sharing

Cost sharing is permitted for proposals under this solicitation; however, cost sharing is not required nor will it be an evaluation factor in the consideration of any Phase I proposal.

### 5.10 Joint Ventures or Limited Partnerships

Joint ventures and limited partnerships are eligible provided the entity created qualifies as a small business as defined in Section 2.2 of this solicitation.

### 5.11 Research and Analytical Work

a. For Phase I a minimum of two-thirds of the research and/or analytical effort must be performed by the proposing firm unless otherwise approved in writing by the contracting officer.

b. For Phase II a minimum of one-half of the research and/or analytical effort must be performed by the proposing firm, unless otherwise approved in writing by the contracting officer.

### 5.12 Contractor Commitments

Upon award of a contract, the contractor will be required to make certain legal commitments through acceptance of government contract clauses in the Phase I contract. The outline that follows is illustrative of the types of provisions required by the Federal Acquisition Regulations that will be included in the Phase I contract. This is not a complete list of provisions to be included in Phase I contracts, nor does it contain specific wording of these clauses. Copies of complete general provisions will be made available prior to award.

a. **Standards of Work.** Work performed under the contract must conform to high professional standards.

b. **Inspection.** Work performed under the contract is subject to government inspection and evaluation at all reasonable times.

c. **Examination of Records.** The Comptroller General (or a fully authorized representative) shall have the right to examine any directly pertinent records of the contractor involving transactions related to this contract.

d. **Default.** The government may terminate the contract if the contractor fails to perform the work contracted.

e. **Termination for Convenience.** The contract may be terminated at any time by the government if it deems termination to be in its best interest, in which case the contractor will be compensated for work performed and for reasonable termination costs.

f. **Disputes.** Any dispute concerning the contract which cannot be resolved by agreement shall be decided by the contracting officer with right of appeal.

g. **Contract Work Hours.** The contractor may not require an employee to work more than eight hours a day or forty hours a week unless the employee is compensated accordingly (that is, receives overtime pay).

h. **Equal Opportunity.** The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

i. **Affirmative Action for Veterans.** The contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran or veteran of the Vietnam era.

j. **Affirmative Action for Handicapped.** The contractor will not discriminate against any employee or applicant for employment because he or she is physically or mentally handicapped.

k. **Officials Not to Benefit.** No member of or delegate to Congress shall benefit from the contract.

l. **Covenant Against Contingent Fees.** No person or agency has been employed to solicit or secure the contract upon an understanding for compensation except bona fide employees or commercial agencies maintained by the contractor for the purpose of securing business.

m. **Gratuities.** The contract may be terminated by the government if any gratuities have been offered to any representative of the government to secure the contract.

n. **Patent Infringement.** The contractor shall report each notice or claim of patent infringement based on the performance of the contract.

**o. Military Security Requirements.** The contractor shall safeguard any classified information associated with the contracted work in accordance with applicable regulations.

**p. American Made Equipment and Products.** When purchasing equipment or a product under the SBIR funding agreement, purchase only American-made items whenever possible.

### 5.13 Additional Information

**a. General.** This Program Solicitation is intended for information purposes and reflects current planning. If there is any inconsistency between the information contained herein and the terms of any resulting SBIR contract, the terms of the contract are controlling.

**b. Small Business Data.** Before award of an SBIR contract, the government may request the proposer to submit certain organizational, management, personnel, and financial information to confirm responsibility of the proposer.

**c. Proposal Preparation Costs.** The government is not responsible for any monies expended by the proposer before award of any contract.

**d. Government Obligations.** This Program Solicitation is not an offer by the government and does not obligate the government to make any specific number of awards. Also, awards under this program are contingent upon the availability of funds.

**e. Unsolicited Proposals.** The SBIR Program is not a substitute for existing unsolicited proposal mechanisms. Unsolicited proposals will not be accepted under the SBIR Program in either Phase I or Phase II.

**f. Duplication of Work.** If an award is made pursuant to a proposal submitted under this Program Solicitation, the contractor will be required to certify that he or she has not previously been, nor is currently being, paid for essentially equivalent work by an agency of the Federal Government.

**g. Classified Proposals.** If classified work is proposed or classified information is involved, the offeror to the solicitation must have, or obtain, security clearance in accordance with the Industrial Security Manual for Safeguarding Classified Information (DoD 5220.22M).

## 6.0 SUBMISSION OF PROPOSALS

An original plus (4) copies of each proposal or modification will be submitted, in a single package, as described below, to the point of contact specified for the topic in Section 8.0.

**NOTE: THE ORIGINAL OF EACH PROPOSAL MUST CONTAIN A COMPLETED RED COPY OF APPENDIX A (COVER SHEET) AND APPENDIX B (PROJECT SUMMARY), AND A COMPANY COMMERCIALIZATION REPORT (see Section 3.4.n).**

### 6.1 Address

Each proposal or modification package must be addressed to that DoD Component address which is identified for the specific topic in Section 8.0 to this solicitation.

The name and address of the offeror, the solicitation number and the topic number for the proposal must be clearly marked on the face of the envelope or wrapper.

Mailed or handcarried proposals must be delivered to the address indicated for each topic. Secured packaging is mandatory. The DoD Component cannot be responsible for the processing of proposals damaged in transit.

All copies of a proposal must be sent in the same

package. Do not send separate information copies or several packages containing parts of the single proposal.

### 6.2 Deadline of Proposals

Deadline for receipt of proposals at the DoD Component is 2:00 p.m. local time, April 14, 1995. Any proposal received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before an award is made, and: (a) it was sent by registered or certified mail not later than April 7, 1995 or (b) it was sent by mail and it is determined by the government that the late receipt was due solely to mishandling by the government after receipt at the government installation.

**Note: There are no other provisions for late receipt of proposals under this solicitation.**

The only acceptable evidence to establish (a) the date of mailing of a late-received proposal sent either by registered mail or certified mail is the U. S. Postal Service postmark on the wrapper or on the original receipt from the U. S. Postal Service. If neither postmark shows a legible date, the proposal shall be deemed to have been mailed

late. The term postmark means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed on the date of mailing by employees of the U. S. Postal Service. Therefore, offerors should request the postal clerk to place a hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper; (b) the time of receipt at the government installation is the time-date stamp of such installation on the proposal wrapper or other documentary evidence of receipt maintained by the installation.

Proposals may be withdrawn by written notice or a telegram received at any time prior to award. Proposals may also be withdrawn in person by an offeror or his authorized representative, provided his identity is made known and he signs a receipt for the proposal. (NOTE: the term telegram includes mailgrams.)

Any modification or withdrawal of a proposal is subject to the same conditions outlined above. Any modification may not make the proposal longer than 25 pages (excluding company commercialization record). Notwithstanding the above, a late modification of an otherwise successful proposal which makes its terms more favorable to the government will be considered at any time it is received and may be accepted.

### 6.3 Notification of Proposal Receipt

Proposers desiring notification of receipt of their proposal must complete and include a self-addressed

stamped envelope and a copy of the notification form (Reference A) in the back of this brochure. If multiple proposals are submitted, a separate form and envelope is required for each. Notification of receipt of a proposal by the government does not by itself constitute a determination that the proposal was received on time or not. The determination of timeliness is solely governed by the criteria set forth in Section 6.2.

### 6.4 Information on Proposal Status

Evaluation of proposals and award of contracts will be expedited, but no information on proposal status will be available until the final selection is made. However, contracting officers may contact any and all qualified proposers prior to contract award.

### 6.5 Debriefing of Unsuccessful Offerors

Upon written request and after final award decisions have been announced, a debriefing will be provided to unsuccessful offerors for their proposals.

### 6.6 Correspondence Relating to Proposals

All correspondence relating to proposals should cite the SBIR solicitation number and specific topic number and should be addressed to the DoD Component whose address is associated with the specific topic number.

## 7.0 SCIENTIFIC AND TECHNICAL INFORMATION ASSISTANCE

### 7.1 DoD Technical Information Services Available

Recognizing that small businesses may not have strong technical information service support, the Defense Technical Information Center (DTIC) is prepared to give special attention to the needs of DoD SBIR Program participants.

DTIC, a major component of the DoD Scientific and Technical Information Program, serves DoD and other federal agencies and their contractors by providing access to and transfer of scientific and technical information resulting from and describing DoD-funded research and development.

The information assistance provided by DTIC enables organizations preparing R&D proposals to DoD to make better-informed bid decisions and technically stronger submittals. DTIC prepares a Technical Information Package (TIP) for most SBIR topics. TIPs contain a bibliographic listing of technical reports from DoD-funded work in technical areas related to the SBIR topic. TIPs may also include additional information provided by the

topic author and references to other information sources.

Firms responding to this solicitation are encouraged to use Reference B at the back of this solicitation or telephone DTIC for background information covering their proposal topic areas. DTIC will return the material you request, annotated with a temporary user code for use when requesting additional information or when ordering technical reports cited in a bibliography. To support SBIR proposal preparation, reasonable quantities of technical reports from the DTIC collection are available at no cost.

Internet access to the current DoD SBIR and STTR solicitations as well as the Phase I and Phase II Award Abstracts publications is provided by DTIC. These files may be accessed via gopher at Internet address: <gopher.dtic.dla.mil> on port 70, or through file transfer at Internet address: <asc.dtic.dla.mil> (login is "anonymous", password is : your E-Mail address), under the /pub/sbir directory.

Call, or visit (by prearrangement) DTIC at the following location which is most convenient to you. All written communications with DTIC must be made to the



Alexandria, VA, address.

Defense Technical Information Center  
ATTN: DTIC-User Services  
Building 5, Cameron Station  
Alexandria, VA 22304-6145  
(800) 363-7247 (800 DOD-SBIR)  
(703) 274-6902  
(703) 274-9274 (FAX)

DTIC Boston Regional Office  
Building 1103, 5 Wright Street  
Hanscom AFB  
Bedford, MA 01731-5000  
(617) 377-2413

DTIC Dayton Regional Office  
2690 C Street, Suite 4  
Wright-Patterson AFB, OH 45433-7552  
(513) 225-7905

DTIC Albuquerque Regional Office  
PL/SUL  
3550 Aberdeen Ave, SE  
Kirtland AFB, NM 87117-6008  
(505) 846-6797

DTIC Los Angeles Regional Office  
222 N. Sepulveda Blvd., Suite 906  
El Segundo, CA 90245-4320  
(310) 335-4170

For information services in the areas of manpower, personnel, training and simulation devices, human factors and safety, contact the DTIC Manpower and Training Research Information System (MATRIS):

DTIC MATRIS Office  
ATTN: DTIC-AM, Sally Ames  
San Diego, CA 92152-6800  
(619) 553-7008

DTIC also provides access to specialized reference services and subject matter expertise within the DoD-sponsored Centers for Analysis of Scientific and Technical Information (IACs). IACs are concerned with the Scientific and Technical Information content of worldwide engineering, technical and scientific documents and databases. For more information on how to utilize the DTIC IAC program and other DoD IACs contact:

Defense Technical Information Center  
DTIC-IAC Program Manager  
Alexandria, VA 22304-6145  
(703) 274-6260  
(703) 274-0980 (FAX)

## 7.2 Other Technical Information Assistance Sources

Other sources provide technology search and/or document services and can be contacted directly for service and cost information. These include:

National Technical Information Services  
5285 Port Royal Road  
Springfield, VA 22161  
(703) 487-4600  
(703) 321-8547 (FAX)

National Technology Transfer Center  
Wheeling Jesuit College  
316 Washington Ave  
Wheeling, WV 26003  
(800) 678-6882

University of Southern California  
Technology Transfer Center  
3716 South Hope Street, Suite 200  
Los Angeles, CA 90007-4344  
(800) 872-7477 (outside CA)  
(213) 743-6132  
(213) 746-9043 (FAX)

Center for Technology Commercialization  
Massachusetts Technology Park  
100 North Drive  
Westborough, MA 01581  
(508) 870-0042  
(508) 366-0101 (FAX)

Great Lakes Technology Transfer Center/Battelle  
25000 Great Northern Corporate Center, Suite 260  
Cleveland, OH 44070  
(216) 734-0094  
(216) 734-0686 (FAX)

Midcontinent Technology Transfer Center  
Texas Engineering Experiment Station  
The Texas A&M University System  
237 Wisenbaker Engineering Research Center  
College Station, TX 77843-3401  
(409) 845-8762  
(409) 845-3559 (FAX)

Mid-Atlantic Technology Applications Center  
University of Pittsburgh  
823 William Pitt Union  
Pittsburgh, PA 15260  
(800) 257-2725  
(412) 648-7000  
(412) 648-7003 (FAX)

Southern Technology Application Center  
 University of Florida, College of Engineering  
 Box 24, One Progress Boulevard  
 Alachua, FL 32615  
 (904) 462-3913  
 (800) 225-0308 (outside FL)  
 (904) 462-3898 (FAX)

### 7.3 DoD Counseling Assistance Available

Small business firms interested in participating in the SBIR Program may seek general administrative guidance from small and disadvantaged business utilization specialists located in various Defense Contract Management activities throughout the continental United States. These specialists are available to discuss general administrative requirements to facilitate the submission of proposals and ease the entry of the small high technology business into the Department of Defense marketplace. The small and disadvantaged business utilization specialists are expressly prohibited from taking any action which would give an offeror an unfair

advantage over others, such as discussing or explaining the technical requirements of the solicitation, writing or discussing technical or cost proposals, estimating cost or any other actions which are the offerors responsibility as outlined in this solicitation. (See Reference C at the end of this solicitation for a complete listing, with telephone numbers, of Small and Disadvantaged Business Utilization Specialists assigned to these activities.)

### 7.4 State Assistance Available

Many states have established programs to provide services to those small firms and individuals wishing to participate in the Federal SBIR Program. These services vary from state to state, but may include:

- Information and technical assistance;
- Matching funds to SBIR recipients;
- Assistance in obtaining Phase III funding.

Contact your State Government Office of Economic Development for further information.

## 8.0 TECHNICAL TOPICS

Section 8 contains detailed topic descriptions outlining the technical problems for which DoD Components request proposals from small businesses for innovative R&D solutions with a high probability of achieving technology transfer for commercialization. Topics for each participating DoD Component are listed and numbered separately. Each DoD Component Topic Section contains topic descriptions, addresses of organizations to which proposals are to be submitted. Read and follow these instructions carefully to help avoid administrative rejection of your proposal.

<u>Component Topic Sections</u>	<u>Pages</u>
Army Laboratory . . . . .	15
Navy Laboratory . . . . .	23
Air Force Laboratory . . . . .	33

Appendices A, B and C follow the Component Topic Sections. Appendix A is a red-printed Proposal Cover Sheet, Appendix B is a red-printed Project Summary form, and Appendix C is an outline for the Cost Proposal. An original red-printed copy of Appendix A and Appendix B must be included with each proposal submitted.

# OFFICE OF THE SECRETARY OF DEFENSE SBIR TOPICS

## U.S. Army Laboratory Topics

**TOPIC:** OSD95-001    **TITLE:** Flexible Automated Finishing of Non-Axisymmetric Precision Optics

**POINT OF CONTACT:** U.S. Army Tank Automotive and Armament Command  
ATTN: AMSTA-AR-ASC (Mr. Tony Desmond)  
Building 1  
Picatinny Arsenal, NJ 07806-5000  
(201) 724-6448

**CRITICAL OR KEY TECHNOLOGY:** Precision optics are utilized in almost all US military weapons systems. Visible and Infrared-transmissive optical elements are used in night vision equipment, telescopic sights, laser rangefinder/designators, and seeker missiles. The need for new types of precision optics will further increase with the development of optical data processing and memories. The capabilities and affordability of these systems are bounded by the limits of optical manufacturing. This presently restricts optical design to spherical and plano component shapes. Affordable non-axisymmetric optics would open up new possibilities for electro-optical system front ends, displays optical computers and even conventional optical sights.

**OBJECTIVE:** Develop process and machinery to enable the flexible automated finishing of non-axisymmetric (cylinders, toroids) optics, that is, smoothing to 10 Angstroms RMS surface roughness and figuring to 1/10 wave.

**DESCRIPTION:** Deterministic microgrinding processes have been applied to flexible automated fabrication of spherical and plano optical surfaces. This has been accomplished at the Center for Optics Manufacturing (COM) in Rochester, NY. The extension of these techniques to the fabrication of non-axisymmetric optics will require new computer-controlled fabrication technology for final smoothing and precision figuring. This program will develop and prototype a system to perform this function. Both phases of this effort must be coordinated with the COM and participate in its concurrent engineering process. Following is a description of the effort by phase:

Phase I: (one year) A concept for non-axisymmetric optical finishing will be developed. The processes and system will be amenable to the optics shop environment, affordable to a small optics supplier, and environmentally friendly. A design and execution plan for Phase II will be included in the final report.

Phase II: (two years) The finishing machine for non-axisymmetric optics will be built and tested. Cylindrical and toroidal optical elements made from optical glass materials will be finished. SPC data will be collected on production runs to determine accuracy and repeatability. Cycle times will be measured. This information will be used to predict the cost for non-axisymmetric optical components made by this method. A design for a commercial version of the machine will be included in the final report.

**DUAL-USE COMMERCIALIZATION:** This program will make new classes of optics available to the designers and manufacturers of optical systems, both military and civilian. This will revolutionize future designs for robotic vision, television cameras, HDTV, laser scanners, laser rangefinders, telescopic sights, night vision, optical computers, optical memories, displays, virtual reality, missile seekers, and medical equipment.

### REFERENCES:

1. "Computer-Aided Optics Manufacturing", Optics & Photonics News, pp. 15-19, June 1994.

2. "Doing More With Less" Optics and Photonics News, pp 21-27, June 1994
3. "Magnetorheological Finishing", Optics and Photonics News, P.16, December 1993
4. "Microgrinding Makes UltrasMOOTH Optics Fast", Laser Focus World, July 1992
5. "Elements and Devices Based on Magnetorheological Effect" Journal of Intelligent Material Systems and Structures, Volume 4, Jan 93.

**TOPIC:** OSD95-002    **TITLE:** Intelligent Information Presentation for a Helmet Mounted Display in a Synthetic Environment

**POINT OF CONTACT:** U.S. Army Aviation and Troop Command  
ATTN: AMSAT-R-NSJ (Mr. Roy Warhover)  
4300 Goodfellow Blvd.  
St. Louis, MO 63120-1798  
(314) 263-0360

**OBJECTIVE:** To develop an innovative and intelligent information presentation for a Helmet Mounted Display (HMD) as aircraft flight regimes change.

**DESCRIPTION:** Future methods of providing appropriate and timely information to the rotorcraft pilot via an HMD will require significant improvements to meet mission and pilotage requirements. Categories of information already envisioned for the HMD display include flight, navigation, system, obstacle avoidance, virtual switching and warnings, weapons status, and target acquisition. Research has shown that this volume of data leads to pilot information overload. Advances in intelligent information presentation as well as prioritization and filtering of flight mode information need to be achieved to obtain an essential high level of performance during low altitude night operations. As the rotorcraft moves from hover and low speed flight, to cruise and maneuver modes of flight operation, the symbologies displayed should intelligently and automatically make the same timely transitions. Manual mode selection of display information in use today was developed in the late 1970s. Manual mode selection does not take advantage of data bus and electronic cockpit monitoring systems that could provide automatic and intelligent information updates. Manual mode switching increases pilot workload and often results in unnecessary display icons that clutter the pilot's synthetic environment. Current technology does not provide the intelligent information presentation requirements necessary in future aircraft. Reduced pilot workload, safer flight envelopes, the encouragement of low-cost HMD development and use in the civil sector, and simpler pilot-vehicle interface with reduced switchology are all goals of this SBIR.

Phase I: Using several design principles, identify and evaluate innovative flight and mission information mode switching concepts necessary for representative aviation missions. Then, using a baseline which is representative of current technology, select several candidate intelligent information prioritization/filtering techniques to demonstrate the potential increase in pilotage and mission effectiveness.

Phase II: Preliminary evaluations of intelligent information presentation concepts for an HMD will be performed in both ground and in-flight simulation to verify improvement potential. Complete definition of intelligent moding characteristics of the most promising configuration will be verified in flight tests on helicopters with HMD systems.

**DUAL USE COMMERCIALIZATION:** This automatic moding HMD technology will have multiple applications in civil sectors in the area of emergency services including police, ambulance, forestry, and fire protection. Civilian resources are increasingly being tasked to monitor and assist in border surveillance, neighborhood surveillance, fire emergencies, highway patrols, forest protection, police reinforcement, and rescue service. Rotorcraft play a unique role meeting the civilian sector needs in all of these areas. These activities represent a growing market for rotorcraft; especially, in high population density areas. It is these high

density areas where safety of flight issues are magnified and where intelligent flight moding will be most useful.

**TOPIC:** OSD95-003    **TITLE:** Thermal Imaging for Medical Diagnosis

**POINT OF CONTACT:**        Communications Electronics Command  
                                 Night Vision Electronics Sensors Directorate  
                                 ATTN: AMSEL-RD-NV-D (Dr. Ratches)  
                                 10221 Burbeck Road, Suite 430  
                                 Ft. Belvior, VA 22060-5806  
                                 (703) 704-1166

**TECHNOLOGY:** Second Generation Scanning Thermal Imaging

**OBJECTIVE:** Investigate and develop innovative designs and packaging of high sensitivity Second Generation thermal imaging for non-intrusive medical diagnosis. Sensitivities in the tens of milli-kelvin degrees range have been demonstrated in the latest developments in military systems based upon PV mercury cadmium telluride focal plane array technology. The goal is to establish the feasibility of using passive infrared imaging to detect and diagnose medical conditions, such as cancer and circulatory problems.

**DESCRIPTION:** The Army is in engineering development of advanced thermal imaging systems for integration into large weapons platforms, e.g., tanks, helicopters, gun systems, and missiles, which require large optics, power sources, processing, etc. The sensitivity available in this technology, when packaged in a small volume and used close up to a subject, could be used to detect very small temperature differences on a body's surface that are due to physiological problems. Such a device could then be used as a passive, non-intrusive diagnostic tool for doctors.

Phase I: Develop a design for a medical thermal imager, using focal plane array technology, which can be used by medical professionals in hospitals or offices to detect and diagnose medical disorders.

Phase II: Fabricate and demonstrate a diagnostic tool based upon Second Generation thermal imaging.

**DUAL-USE COMMERCIALIZATION:** A medical diagnostic tool, such as described above, not only has enormous civilian application, but can also be of significant benefit to military casualty diagnosis on the battlefield. Employment of this technology in combat field or shipboard hospitals could improve the timeliness for determination of the nature and location of wounds by passive, real time means.

**REFERENCES:**

1. Van Derlaske, Bohan, Graves, "Second Generation FLIR Horizontal Technology Integration", Proceedings of National IRIS, Eglin AFB, FL, 24-26 May 1994.
2. Van Derlaske, "Horizontal Technology Integration (HTI) of 2nd Generation Thermal Imaging", Proceedings of the Night Operations Symposium XI, Las Vegas, NV, 7-10 February 1994.
3. Hall, "Technology Applications for Next Generation Night Vision Equipment", Proceedings of SPIE OE/Laser Conference, Los Angeles, CA, 26 January 1994.

**TOPIC:** OSD95-004    **TITLE:** Inexpensive Intrusion Detectors

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**TECHNOLOGY:** Staring, Uncooled Thermal Imaging

**OBJECTIVE:** Develop and demonstrate a small, lightweight, low power, uncooled thermal imager that will be affordable for the home security market.

**DESCRIPTION:** Uncooled thermal imaging, based upon staring pyroelectric detector array, has been demonstrated for low to medium performance target acquisition applications. The cost of such devices is relatively inexpensive in military affordable terms and the technology has been transferred to the automobile industry for night driving aids. Innovative designs and device concepts are required in order to demonstrate significantly greater improvements that would enable the fabrication of devices at a cost that made them inexpensive enough for mass production home protection systems.

Phase I: Investigate cost reduction designs for uncooled thermal imagers and innovative device designs to significantly lower the cost of these devices.

Phase II: Fabricate and demonstrate an uncooled thermal imaging device which can be projected to be affordable for the mass home security systems market.

**DUAL-USE COMMERCIALIZATION:** Imaging devices that are affordable for home protection would be applicable to many security missions in the services; base intrusion, armory security, military police, remote sentries, robots, etc.

**REFERENCES:**

1. Royal, Miller, "Uncooled Thermal Imaging Systems", Proceedings of SPIE, Orlando, FL, 5-8 April 1994.

**TOPIC:** OSD95-005    **TITLE:** Fluid-Filled O-Ring for Maintaining a Seal Under Low Temperature Conditions

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**TECHNOLOGY:** Engineering Sciences

**OBJECTIVE:** Extend capabilities of fluid-filled O-ring to include high temperature applications.

**DESCRIPTION:** Recently, a patent was issued to an Army engineer on a fluid-filled O-ring for maintaining a seal under low temperature conditions. O-rings serve the critical function of sealing devices in containers, components, pressure vessels, pipes, structures and machines in which pressurized fluids or gases are prevented

from leaking out. The degree of sealing depends on how well the O-ring cross section can deform and deflect from the circular shape to an oval section thus filling up any gap around it and resting tightly against the two walls of the two concentric components. Unfortunately, most elastomeric O-ring seals lose their resilience (flexibility) at low temperature and are not effective sealers. In fact, the disaster of Space Shuttle Challenger happened because the unusual low temperature of the launch site stiffened the solid rocket booster O-ring seal and reduced its sealing capacity leading to the accident. The objective of the new elastomeric O-ring design is to provide an improved O-ring seal for subzero temperatures that does not stiffen when introduced to a low temperature and cause a situation of imperfect sealing.

This technology, developed by the Army, demonstrated the feasibility of making an O-ring that can seal at low temperatures. To make this technology commercially viable, further development of the O-rings is needed to accommodate high-temperature applications, such as for a standard internal combustion engine.

Phase I: Develop a preliminary O-ring designed for low-temperature uses using one standard material for the O-ring and perform preliminary tests to determine high-temperature tolerance for a standard-type, commonly used industry sealing device.

Phase II: Develop a prototype or series of prototypes for high-temperature applications common in industry and test in a simulated industrial application. Develop application specifications for the one type of O-ring material.

**DUAL-USE COMMERCIALIZATION:** These fluid-filled O-rings have very high potential for private industry uses for components that are used to contain fluids or gas and that are subject to cold environmental effects. Such components include those using automotive technology, pressure vessels, pipes, and pumps. Military uses include much of the same and may also include high-power engines and launchers.

**TOPIC: OSD95-006    TITLE: Biosensor Technology and Miniaturization**

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**OBJECTIVE:** The objective of the project is to fabricate a prototype hand-held biosensor able to detect toxins, bacteria, and/or viruses. Sub-objectives to meet the main goal are: investigate the potential of new detection approaches or modify established ones; fabricate a Phase I deliverable for testing at ERDEC; continue to miniaturize and test the Phase I design in Phase II with emphasis on ease-of-use (automation), low power consumption, rapid response, and high sensitivity; deliver the final product to ERDEC.

**DESCRIPTION:** Sensor types that are currently being investigated at ERDEC are the Light Addressable Potentiometric Sensor (LAPS), the Surface Plasmon Resonance (SPR) Sensor, Electrochemiluminescence Sensor, and the Fiber Optic Waveguide (FOWG). Other technologies have been considered in the past or are under review such as bioelectrochemistry and other optical methods. The Army requires miniaturized (hand-held) biosensors that can operate continuously for at least 24 hours and that can rapidly and unambiguously identify bioagents of concern. All approaches being considered involve antibody based assays although DNA probes and receptor based detection are also being investigated and are applicable for this solicitation.

Phase I: The phase I project will involve an experimental program to either downsize or otherwise modify a particular well-developed sensor technology (ie. LAPS, SPR, FOWG, ECL) or to demonstrate the feasibility of using another technology in a miniaturized sensor design. The contractor will concentrate on

detection methods and designs that use low power consumption and enable the system to be hand-held. Any approach must detect a model biomolecule of interest to the Government at response and sensitivity levels within current detection requirements. A prototype will be one of the deliverables at the end of the effort.

Phase II: The phase II objective will be to optimize the design concepts explored in Phase I, to produce improved prototypes, and to incorporate a variety of assays of interest to the Government. By the end-of-effort, the contractor will provide a final sensor system that meets the requirements laid out in the General section above.

**DUAL-USE COMMERCIALIZATION:** The work described in this topic has applications for detecting a variety of substances of interest to clinical and environmental markets.

**TOPIC: OSD95-007    TITLE: Innovative Approaches to Vaccine Delivery**

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**TECHNOLOGIES:** C13 Chemical and Biological Systems

**OBJECTIVE:** To demonstrate the feasibility of delivering vaccines which would provide protection for multiple years by means other than the traditional needle and syringe.

**DESCRIPTION:** Most vaccines require multiple boosters and are given parenterally by needle and syringe. The procedure is tedious for mass immunizations and not without risk due to needle stick injuries. Desirable are vaccines which require a single administration either orally or by some other means amenable for mass immunizations, including administration of polynucleotide vaccines. Of principal interest are viral diseases (e.g. vaccinia, hantaviruses, tick-borne encephalitis virus, equine encephalitis viruses), bacterial diseases (e.g. anthrax, plaque), and toxins (e.g. botulinum toxin, staphylococcal enterotoxins).

Phase I: Demonstrate feasibility in laboratory animals using a vaccine against agents listed above.

Phase II: Preclinical trials to support IND submission.

**DUAL-USE COMMERCIALIZATION:** Specifically, vaccines to agents mentioned above could be marketed around the world especially to foreign travelers and in countries with endemic disease. The technology developed would be applicable to any vaccine and thus of major interest to groups such as the Children's Vaccine Initiative.

**TOPIC: OSD95-008    TITLE: Flame Resistant Textiles Using Microencapsulated Flame Retardants**

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**TECHNOLOGY:** Advanced Materials and Processing

**OBJECTIVE:** Investigate the use of microencapsulated flame retardants to improve the flame resistance of textiles used for tentage, clothing and individual equipment.

**DESCRIPTION:** Flame resistance remains one of the most difficult characteristics to achieve with new textiles, while being extremely important for our soldier's safety. Many advances have been recently made using microencapsulated substances for improved product performance. This effort will concentrate on using this technology to replace or improve current textile flame retardant treatments.

Phase I: The technical feasibility of using microencapsulation for flame resistant textiles will be established. Potential flame retardants will be identified, the most effective microencapsulation technique determined, and methods of incorporating the microcapsules onto various textile products proposed. The target fabrics shall include breathable, coated and laminated fabrics currently used for tentage, clothing and individual equipment and new textile products previously excluded due to their lack of flame retardance. The study will result in a trade-off analysis comparing performance, safety and manufacturing issues of the proposed solutions to existing products.

Phase II: The most promising concepts of phase I will be expanded and laboratory trials conducted. Laboratory strike-offs of potential products will be tested and compared to existing fabrics. Full-scale manufacturing issues will be resolved and pilot production runs completed. Adequate material will be supplied to enable full-scale fabrication and testing of representative tentage, clothing and individual equipment.

**DUAL-USE COMMERCIALIZATION:** This technology has wide-reaching commercial application wherever flame resistant textiles are required such as camping tents, clothing, sleeping bags, draperies, carpeting, and aircraft interiors.

**REFERENCES:**

1. "Microscopic Parcels Deliver the Goods," Chemical Engineering, March 1993.

**TOPIC:** OSD95-009    **TITLE:** Optical Vibration Monitors in Gas Turbine Engines for Prognostic and Diagnostic Applications

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**TECHNOLOGY:** Advanced Propulsion Technologies

**OBJECTIVE:** Develop optical vibration monitors for inspection of gas turbine engines.

**DESCRIPTION:** Optical vibration monitors are used in the LV100 engine to determine the condition of the blades. This application is limited to laboratory testing only. Recent advancements in the optics and the electronic instrumentation should make such a system economical for field application to inspect production engines. If provided, such systems can be used to determine the condition of the rotor blades in the engine. This information will be available for scheduling maintenance and minimize the engine down time.

Phase I: Conduct the market survey and determine the state-of-the-art technology. Design a cost

effective system for application in a production engine.

Phase II: Procure the system and demonstrate in an engine.

**DUAL-USE COMMERCIALIZATION:** If such a prognostic and diagnostic system can be made simpler and cost effective it can become a standard tool for maintenance of production gas turbine engines.

## U.S. Navy Laboratory Topics

**TOPIC:** OSD95-010    **TITLE:** Dental Conduction Hearing for Divers

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**TECHNOLOGY:** Sensors, Materials and Structures, Human-System Interfaces

**OBJECTIVE:** Develop technology to permit hearing via bone conduction through the teeth using a low voltage transducer built into a scuba mouthpiece.

**DESCRIPTION:** The objective is based on materials technology conceived and developed by the Government and spun off to the civilian sector. The rare earth magnetostrictive material, Terfenol-D, developed by the Navy, permits high power transduction with very low voltage and thus a safe system for installation inside the mouth. Audiodontics, Inc. (located in Bethesda, MD and willing to license) and the University of Maryland Dental School have developed a bone conduction hearing aid using a very small Terfenol transducer which attaches to a tooth and transmits vibrations from a wireless hearing aid. The hearing aid was developed for people who cannot use normal hearing aids because of infections or bone growth. Vibrating the tooth accomplishes hearing via bone conduction. The transducer is excited by a small receiver fitted to a retainer on the wearer's palate. Signals are transmitted to this device from a shirt-pocket-mounted hearing aid. This is a significant advance in this hearing technology in that it eliminates the need for a traditional bone contact transducer behind the ear which encourages skin abrasion and subsequent infection.

The civilian and military diving communities utilize diver communication systems which use ordinary earphone technology to permit a diver to hear instructions, commands, or sonar system output. This necessitates special head gear to allow the wearing of air-conduction earphones. In the specific case of divers using a diver-held mine-hunting/detection system, the earphones used to hear sonar echoes are far from comfortable and effective. The initial approach to adapting this technology to the problem is to design and develop a transducer immersed in the diver's mouthpiece which will permit coupling of sound from the mouthpiece into the teeth of the diver. An air path will be unnecessary.

Phase I. The contractor will design and fabricate a prototype transducer mounted in a scuba diver mouthpiece and demonstrate sound transmission.

Phase II. The contractor will design and develop a complete system which will take the output of a sonar system or communications set and transmit the sound to the diver using the mouthpiece. Techniques will be developed to clue the diver to perceived sound direction via alternative means.

**DUAL-USE COMMERCIALIZATION.** The technology will be incorporated into diver-held sonar imaging systems and diver communications systems.

### REFERENCES:

1. U.S. Patent Number 503300, Method for Endodontically Augmenting Hearing, 23 July 1991.
2. "Chew On This: The Hearing Aid Attaches To Teeth." Engineering News Item in Design News, 13 June 1994

3. "Tiny Actuators." Technology Focus Item in Mechanical Engineering, June 1994, p. 32.

**TOPIC:** OSD95-011    **TITLE:** Integrated Model/Measurement Comparison Tools

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**TECHNOLOGY:** Software

**OBJECTIVE:** To develop commercial software tools that allow the generation of high-fidelity synthetic background measurements and their seamless intercomparison with analogous empirical observations. These tools should employ current Navy-developed interactive data visualization and analysis tools and high-fidelity synthetic scene simulation technologies.

**DESCRIPTION:** The Navy is chartered by the Ballistic Missile Defense Organization (BMDO) to assemble, manage, disseminate and support the analysis of measurements of terrestrial, atmospheric, and celestial backgrounds from BMDO-sponsored and related experiments. The ultimate utility in the Navy datasets resides in their ability to promote and enhance defense and dual-use civilian studies which might employ these data. Software tools to better exploit these datasets by closely linking their analysis and visualization with the output from scientific models will make this data exploitation more effective and will also have comparable utility in civilian and military remote sensing applications.

A software package is needed which combines the capability to generate high-fidelity synthetic measurements and easily contrast them with comparable or identical empirical measurements such as those in the Navy archive. The package should use state-of-the-science simulation technology like the Navy-developed Synthetic Scene Generation Model (SSGM) to produce the simulated data and take into account the effects of the observing platforms and sensor on the synthetic measurements. In addition the package should integrate this scene simulation technology with interactive data visualization and analysis tools such as the Navy-developed Visual Interface for Space and Terrestrial Analysis.

This resulting data simulation and analysis tool should integrate those components of the DoD-developed simulation and visual analysis technologies which are most applicable to the ultimate development of a commercial product. Currently, these tools run on Silicon Graphics, Inc. scientific workstations. A suitable negotiated agreement will have to be reached in the final phase of this project with respect to the ownership and licensing of the resulting software package.

**PHASE I:** Develop a detailed design for a proof-of-concept integrated analysis tool which leverages existing DoD simulation and visualization technologies and tools as identified above. This design should identify simulation and analysis functions, specify the interfaces between the components of an integrated tool, and generate sample strawman output products from the existing tools to help define the component interfaces and to quantify and refine the final system design.

**PHASE II:** Implement the detailed design developed in Phase I and produce a working proof-of-concept system. Demonstrate the proof-of-concept system on an appropriate dataset which has the potential for dual-use or commercial exploitation.

**DUAL-USE COMMERCIALIZATION:** Integrated packages to generate and seamlessly compare spacecraft and

aircraft data collection products have wide applicability in commercial remote sensing for resource management, environmental studies, etc. Such an integrated tool will also have wide applications as well for civilian global change research and DoD surveillance and weapons system development programs.

#### **REFERENCES:**

1. Heckathorn, Harry and Wieland, Frederick, "Physics-Based, High-Fidelity Simulation: Strategic Scene Generation Model", Proceedings of the 1993 Winter Simulation Conference (Evans, G.W., Mollaghasemi, M., Russell, E.C., and Biles, W.E., eds), Society for Computer Simulation, International, 1994, p. 989.
2. Dombroski, E.G., Snyder, W.A., and Heckathorn, H.M., "Metadata Management and the VISTA System", Proceedings of the Twenty-Seventh Annual Hawaii International Conference on System Sciences (Nunamaker, J.F., and Spague, R.F., eds.), IEEE Computer Society Press, 1994, p. 418.

**TOPIC:** OSD95-012    **TITLE:** Trivalent Chromium Conversion Coatings for Aluminum Alloys

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**TECHNOLOGY:** Materials and Structures

**OBJECTIVE:** Introduce Trivalent Chromium Treatment and develop practical approaches to facilitate acceptance.

**DESCRIPTION:** The Navy and other DoD/Military Services utilize chemical chromate conversion coatings, e.g., "Alodine", on aluminum to impart corrosion resistance and to serve as an effective base for paint. However, the chromates (hexavalent chromium form) are highly toxic and present a hazard to operations as well as an adverse impact on the environment. A process has been developed at Navy that utilizes a vastly less toxic trivalent form of chromium to serve as alternative to the chromate process. The trivalent chromium treatment of aluminum has proven highly promising in laboratory tests and is presently being evaluated at several air/fleet facilities for application to aircraft components. This process is considered a potentially viable alternative to chromate coatings used for a multitude of commercial and military end items.

**PHASE I:** Investigate the trivalent chromium process for its beneficial environmental/health aspects at the expense of a somewhat more complicated process with a somewhat lower corrosion resistance in comparison to chromate coatings.

**PHASE II:** Evaluate the trivalent chromium process on a commercial scale for actual items currently utilizing chromate conversion coatings. Develop optimized bath composition for applications to aluminum by brushing or spraying or for bulk treatment of small parts. Addition of surfactant is advisable.

**DUAL-USE COMMERCIALIZATION:** The trivalent chromium process could replace an estimated 25% of current commercial applications for chromate conversion coatings within 5 years after the Government requires such replacement for items procured. Both constituents, analysis methods and replenishment procedures must be developed.

**REFERENCES:**

1. "Trivalent Chromium Solutions for Applying Chemical Conversion Coatings to Aluminum Alloys or For Sealing Anodized Aluminum", F. Pearlstein and V.S. Agarwala, Plating and Surface Finishing, p. 50-55, July 1994.

**TOPIC:** OSD95-013    **TITLE:** Free-space Optical Interconnection Packaging Technology

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**TECHNOLOGY:** Electronic Devices

**OBJECTIVE:** To package existing components into a device for rugged, low-maintenance free-space optical interconnections of electro-optic elements. Devices should demonstrate free-space optical interconnections for future shipboard applications.

**DESCRIPTION:** The Navy is developing optical communication systems for ships of the future. An important element of these systems is a free-space optical interconnection device to connect, switch, relay, or modify optical signals from one optical device to another. To be practical, this device must be able to interconnect 256 or more parallel signals between its input and output stages. On a processing stage, the devices should have some processing to qualify as "smart pixel" devices (preferably switching with a fan-out of 2 or more). Many electro-optic elements have been developed which convert the optical interconnections to and from electronic signals. These elements are typically active sources (e.g., vertical cavity surface emitting laser arrays), modulators, and detectors. Multiple optical sources can be generated by a laser array or by a laser in combination with a lens and grating.

**PHASE I:** Demonstrate packaging in a device consisting of at least 64 parallel interconnections between stages.

**PHASE II:** Build an optical interconnection device for a selected shipboard application. Device should be rugged to Navy shock standards and should provide thermal management of heating. Several models should be provided for Navy laboratory testing.

**DUAL-USE COMMERCIALIZATION:** Optical interconnection devices must be provided for shipboard environmental tests. There will be information highway applications. Free space optical interconnections will be important in fiber optic communications, optical processing, and optical memory usage.

**REFERENCES:**

1. F. B. McCormick, Free-Space Interconnection Techniques, Photonics in Switching Volume II Systems, edited by J.E. Midwinter, Academic Press, Inc., 1993, pp. 169-250.
2. J.L. Brubaker, et. al., "Optomechanics Of A Free Space Photonic Switch: The Components," SPIE Proceedings Vol. 1533, 1991.
3. K. Rastani, et.al., "Integration Of Planar Frenel Microlenses With Vertical-cavity Surface-emitting Laser Arrays," Optics Letters, June 1991, Vol. 16, No. 12, pp. 919-921.
4. A.A. Sawchuk, et. al., "Smart Pixel Optical Computing Architectures," Optical Computing Technical Digest, 1993 (Optical Society of America, Washington, D.C., 1993), Vol. 7, pp. 214-217.

5. F.B. McCormick, "Generation Of Large Spot Arrays From A Single Laser Beam By Multiple Imaging With Binary Phase Gratings," Optical Engineering, April 1989, Vol. 28, No. 4, pp. 229-304.

**TOPIC:** OSD95-014    **TITLE:** Compliant Substrates

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**TECHNOLOGY:** Electronic Devices

**OBJECTIVE:** Demonstrate compliant substrates for Wide Bandgap Semiconductor materials

**DESCRIPTION:** Recently compliant substrate technologies have been demonstrated such that lattice-matched substrates can be supplied for any mole fraction of Si:Ge or II-VI alloy semiconductors. These substrates are created by forcing the misfit dislocations down into a very thin compliant layer rather than permitting the defects to propagate upwards into the epitaxy overlayers. This technology is critical to the new class of wide bandgap semiconductors such as 3C SiC and the various III-N materials for which there are no native (homoepitaxial) substrates.

**PHASE I:** Demonstrate a compliant substrate technique to reduce defect density of 3C SiC, GaN, or AlN materials to less than  $10^6/\text{cm}^3$ .

**PHASE II:** Demonstrate compliant substrates capable of supporting epitaxial overlayers of 3C SiC, GaN, or AlN materials such that defect density is less than  $2 \times 10^4 / \text{cm}^3$ .

**DUAL-USE COMMERCIALIZATION:** The applications enabled by high quality wide bandgap substrates are virtually limitless. Among these are visible and UV LEDs and lasers, higher power IR lasers and LEDs, much higher power microwave and millimeter wave solid state amplifiers, new class B, push-pull ultra linear, ultra efficient microwave and millimeter wave amplifiers, which are needed for satellites, microwave ovens, microwave relay stations, and cellular phones (Iridium project).

**REFERENCES:**

1. T. Chu, F. Santiago, M. Stumborg, & C. Huber "The Role Of Barium In The Heteroepitaxial Growth Of Insulators And Semiconductors On Silicon," Mat. Res. Soc. Symp. Proc., Vol 334, pp 501-6 (1994).
2. A. R. Powell, S.S. Iyer, F.K. LeGoues, "New Approach To The Growth Of Low Dislocation Relaxed Si:Ge Material", Applied Physics Lett., Vol 64, p. 1856 (1994).

**TOPIC: OSD95-015    TITLE: High Temperature Package for Recently Developed Silicon Carbide**

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**TECHNOLOGY:** Materials, Electronics

**OBJECTIVE:** Introduce Navy high temperature packaging technology and develop a commercial high temperature package for silicon carbide electronics.

**DESCRIPTION:** Recent development of silicon carbide electronics that operate at extreme high temperatures has produced the need for packages that can withstand hostile environments at high temperature. High temperature electronics packages today can withstand 150° to 200° C operation only for short periods of time. Silicon carbide electronics operate at such high temperature (above 500° C) that even military specified packages undergo material oxidation, corrosion and structure changes which can cause failure of the package and device. The Navy at NAWCAD Indianapolis, has designed a custom high-temperature package that can withstand constant 500° C operating temperatures. The Navy packages include a developed high-temperature (platinum, gold) bonding wire system for chip interconnections. Prototype packages have been manufacturing and will be subjected to environmental stress testing to ascertain high temperature durability. Testing should be completed by May 1995.

**PHASE I:** Transition the developed high temperature packaging technology to/at the silicon carbide manufacturer. Use the Navy-designed package as a prototype for developing a commercial high temperature package. Develop a package manufacturing process and manufacture prototype commercial packages.

**PHASE II:** Transition the developed prototype commercial package manufacturing process into a commercial process. The objective will be to manufacture a high temperature package capable of continuous use at 500° C which will accompany silicon carbide devices intended for use in hostile environments.

**DUAL-USE COMMERCIALIZATION:** With the rapid development of SiC electronics, a true high temperature package (Navy design) will become available for use in hostile environments. Both military and industry would utilize the developed packages.

**REFERENCES:**

1. Transactions; Second International High Temperature Electronics Conference (HITEC), High Temperature Packaging Sessions, Omni Charlotte Hotel, June 5-10, 1994, Charlotte, N.C.



**TOPIC: OSD95-016    TITLE: Elastomeric Composite Bumpers**

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**TECHNOLOGY:** Materials and Structures

**OBJECTIVE:** To commercialize a highly damage tolerant, high energy absorbing elastomeric matrix composite ship bumper for use in both Naval and commercial shipping applications.

**DESCRIPTION:** The Navy is currently developing highly abrasion resistant and damage tolerant elastomeric matrix composites for use in a wide variety of applications. These materials have exhibited elastic deformations greater than 60% while maintaining significant structural properties. These materials systems have significant potential for use in impact applications such as bumpers for naval and commercial ships as well as moorings in shipyards and commercial marinas. Due to the tailorability of these materials, designs can be developed which are uniquely suited to energy dissipation from impacts of large vessels.

The Navy desires a small business to design and develop novel marine impact bumpers for dual-use military and commercial markets. This program will require materials characterization to develop necessary design data. Development of low cost processing for fabricating these bumper structures is also required in order to provide an appropriate alternative or for retrofitting onto existing structures.

**PHASE I:** Fabrication of structural configurations from the elastomeric matrix composites for characterization of mechanical and impact performance properties. Develop designs and low cost manufacturing concepts for these bumpers.

**PHASE II:** Design and fabricate large subscale test articles using at least two manufacturing processes such as filament winding, resin transfer molding, or pultrusion. Down select to one process for fabrication of a full scale test article to be tested by the customer.

**DUAL-USE COMMERCIALIZATION:** Impact bumpers are utilized in both commercial and military ports and marinas. In addition this technology has applicability in automotive bumpers, highway safety devices and machinery guards.

**REFERENCES:**

1. Crane, Roger M. and Ratchliffe, Colin P., "Graphite/polyurethane Flexible Composites: Mechanical and Vibration Damping Properties", Survivability, Structures and Materials Directorate Research and Development Report, CARDIVNSWC-TR-601-93/02 August 1993, 57 p.
2. Crane, Roger M., Santiago, Armando L. and Ratchliffe, Colin P., "Structural and Damping Characteristics of a Flexible Composite Structure", submitted to International Symposium on Materials for Noise and Vibration Control, 1994 ASME Winter Annual Meeting, Nov. 6-11, 1994.
3. Fischer, Eugene and Crane, Roger M., "Load Bearing Connective Damper", U.S. Patent No. 4,954,377 4 September 1990.
4. Crane, Roger M., Santiago, Armando L., and Jones, Wayne C., "Filament Winding and Resin Transfer Molding of Large Strain to Failure Matrix Systems for Fabrication of Flexible High Damping Composite Structures", Navy Case No. 75971 November 1993.

5. U.S. Patents 5,194,181; 5,232,639; and 5,190,624.

**TOPIC: OSD95-017    TITLE: PAWS Off-Line Programming System**

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**TECHNOLOGY:** Software

**OBJECTIVE:** To increase the productivity in the U.S. shipbuilding industry by infusing the shipyards with information technology which facilitates the link between design and robotics manufacturing. To help achieve this goal, the Off-line Programming Software (OLP) developed as part of the Programmable Automated Welding System (PAWS) Program will be transitioned for commercial use. This software, currently under development offers significant advantages to manufacturing operations employing robotics in small batch operations.

**DESCRIPTION:** The Navy shipbuilding industry and other DoD/Military Services have a need to employ robotics automation technology in small batch manufacturing operations. The desire to employ robotics results from the need for higher productivity and quality. However, to successfully integrate robotics into a small batch manufacturing environment, the efficient programming of the robotics system is essential. The PAWS-OLPS developed by the Navy addresses this need. This software efficiently interfaces with CAD and manufacturing process information to derive the necessary robotics operations for automated welding manufacturing. The architecture of this software easily allows extensions to other manufacturing processes.

However, the PAWS-OLPS currently requires a relatively high level of user expertise and capital investment for computer hardware. Consequently, its acceptance in general manufacturing operations may be limited. Additional links into the software infrastructure of U.S. shipyards taking advantage of emerging national standards are required. Therefore a development effort is proposed to address these constraints.

**PHASE I:** Create an automated interface with CAD systems to eliminate "process" decision making operations and allow the system to "batch" process CAD information.

**PHASE II:** Porting of PC-based solution for both the process planner and the simulation software for a low cost solution, implementing standards used with U.S. shipyards, customizing for specific needs of installation sites, and developing network support structure.

**DUAL-USE COMMERCIALIZATION:** The use of OLPS technology has immediate application in any small-batch robotics manufacturing operation. Both government contractors and commercial manufacturers can benefit from OLPS technology. Prime examples include, the ship building and aerospace industries where use of robotics automation technology has been identified as key technology.

**REFERENCES:**

1. Hemmerle, J., Terk, M., Gursoz, E.I., Prinz, F.B., and Doyle, T.E., "Next Generation Manufacturing Task Planner for Robotic Arc Welding", ISA Transactions of Artificial Intelligence for Engineering, Design and Manufacturing, (cd. S. Rubin), April 1992. Vol. 31, No. 2, pp. 97-114.

**TOPIC: OSD95-018    TITLE: INTEGRATED SURFACE TREATMENT SYSTEM**

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**TECHNOLOGY:** Processing, Materials

**OBJECTIVE:** To provide an extension to integrate the Plasma Spray CNC Workcell focussing on cost-effective repair and refurbishment.

**DESCRIPTION:** The Navy Manufacturing Science & Technology (MS&T) Program previously funded the development of an integrated Plasma Spray CNC Workcell for the repair and refurbishment of large cylindrical parts. This system fully integrated the several steps of workpiece preparation, thermal spray repair, remachining and inspection processes and was intended for use at Navy repair facilities. This system also included the development of certain software tools for efficient process planning. This prototype system met each of the design criteria, but due to budgetary restrictions has not been fielded. Following Navy MS&T dual use objectives, the approaches developed for this prototype system should be adapted to commercial use.

The prime consideration is one of economic viability. The prototype design emphasized quality of refurbishment and producibility. In a commercial environment, other considerations relating to acquisition and maintenance costs, programmability, and ease of use may be as important.

The workcell combines a DC powder plasma spray and CNC turning center and was designed specifically to process cylindrical components such as valve stems, pump and blower shafts, etc., to meet Navy standards and the capability of reducing the skill levels of the operator by providing computer based tools to guide the planning, setup, and execution of the series of processing steps in repairing and refurbishing these components. One of the first tasks should be to establish the commercial viability of this overall approach. Portions of the system development should be closely examined with regard to their ability to satisfy market needs.

**PHASE I:** Conduct an assessment of the market needs for an integrated surface treatment/repair & refurbishment system. Establish realistic performance, and cost goals for viable commercial versions of this system and determine the value of spin-off technologies including the stand-alone process planner. Define the areas for further development of the prototype to improve ease of use, productivity, and quality of repair and refurbishment. The specific requirements of machine cost, software reliability and ease of use must be examined. The extension thermal spray capabilities to HVOF (High Velocity Oxy-Fuel) and other surface treatment processes should be addressed as dictated by market considerations.

**PHASE II:** This phase would include the completion of the systems and software modifications to provide added ease of use, improved maintainability, and enhanced operator interfaces to guide the planning, setup, and execution of workcell functions and the software tools that will meet commercial market needs. This task will also seek to eliminate the use of the grit blasting process within the workcell. The grit option was needed to meet the Navy requirements, but is not the optimal solution. Alternative surface preparation approaches relying on diamond honing, or HVOF surfacing would provide better solutions.

**DUAL-USE COMMERCIALIZATION:** There are a number of viable commercial uses for this technology, but each needs to be tailored to the specific requirement of the process and must meet the economic limitations on cost of acquisition, maintainability, and ease of use. It is likely that this workcell technology can be applied to both retrofit and new equipment. The cost of the turning center is the most serious deterrent. Potential process applications include: the application of specialized coatings to large cylindrical sections; the coating and

refurbishment of shafts and rolls for the paper, steel and aluminum processing industries; and the refurbishment of large rotating machinery shafts for power and energy systems.

**REFERENCES:**

1. "Plasma Spray Workcell Slashes Part Repair Time", Advanced Materials & Processes Forecast '93, ASM Publication, Volume 143, Number 1, January 1993.
2. Blackburn, J., et al., "An Integrated CNC-Plasma Spray Workcell for Machinery Components", National Thermal Spray Conference, June 7-11, 1993, Anaheim, CA.
3. "CNC Cell Automates Thermal Spray", Welding Design & Fabrication, Aug. 1993, p 12.
4. "Repairing Worn Shafts in a Single Setup", American Machinist, Dec. 1993, p 49f.

## U.S. Air Force Laboratory Topics

**TOPIC:** OSD95-019    **TITLE:** Spastic Resistant Stick Controllers

**POINT OF CONTACT:** Armstrong Laboratory  
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**TECHNOLOGY:** Human-Systems Interfaces

**OBJECTIVE:** Stimulate the transition of stick controllers, which have been demonstrated to be resistant to sudden, spastic motion.

**DESCRIPTION:** At the Armstrong Laboratory, a technology with dual-use applications has evolved within the Air Force as a result of studies conducted to find stick controllers that pilots may use in unusual flight environments. A joint program between the Air Force and the Department of Veteran Affairs was conducted to apply this DOD technology to patients with neuromotor disabilities. An extensive data base now exists which demonstrates for pilots, normals, and patients with neuromotor disabilities, that substantial improvement in tracking performance can be obtained for a variety of task situations. This technology can be developed by a small business contractor to further improve on size, cost, and commercial availability of this technology for a wide number of applications. Within the Air Force, several Air Force patents are available for licensing. Proprietary data bases that can be developed for exclusive rights to the small business contractor for his marketing purposes are also available.

**PHASE I:** Phase I will result in engineering specifications for commercialization applications.

**PHASE II:** Phase II will result in fabrication, testing, and validation of spastic resistant stick controllers based on the commercial/military applications assessment.

**DUAL-USE COMMERCIALIZATION:** Some possible uses within the health care industry include: (1) wheelchair stick controllers, (2) input devices into computers (cursor control), and (3) other "spastic resistant" devices for use in the workplace to help employ individuals with some neuromotor disability. Applications outside the health care industry include: (4) video game "steady sticks" and (5) training aids for precision control tasks.

**REFERENCES:**

1. D. W. Repperger, "Active Force Reflection Devices In Teleoperation," IEEE Control Systems Magazine, January, 1991, pp. 52-56. Unclassified. Distribution Unlimited.
2. D. W. Repperger, E. L. Scarborough, and T. L. Chelette, "Construction of A Dual Axis Force Reflection Stick and Test Station," AI-TR-1992-0041, November, 1991. Unclassified. Distribution Unlimited.

**TOPIC:** OSD95-020    **TITLE:** Spontaneous Emission Filter

**POINT OF CONTACT:** Rome Laboratory  
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**TECHNOLOGY:** Telecommunications, Computers, and Electronic Devices

**OBJECTIVE:** Develop a semiconductor spontaneous emission filter device to improve DoD and commercial fiber-optic transmission systems for communications and computer interconnects.

**DESCRIPTION:** As defense and civilian message bandwidth continuously increases, dramatic increases in speed and decreases in cost for both DoD and commercial fiber optic communications and interconnect subsystems are continually required. Ultra-high bandwidth telecommunications or inter-computer interconnects utilizing fiber optic technology must deal with a signal/noise ratio determined in part by spontaneous emission noise produced by source or repeater laser devices in all-optical architecture. Cascaded stages of amplification amplify the spontaneous noise to the point where detection and regeneration are required. A spontaneous emission filter device would provide such amplification without the need for electronic regeneration. Performance increases and cost savings for both DoD and commercial systems could be very significant. The Digital Photonics Branch in the Surveillance & Photonics Directorate at Rome Laboratory has developed such a filter based on our observation that spontaneous emission in an in-plane GaAs laser does not quench lasing activity in a second crossed-cavity laser. Prototype filter devices have been fabricated at Cornell and tested in the Photonics Center at Rome Laboratory, and are now ready for SBIR pickup.

PHASE I: Should involve further development of filter designs based on the demonstrated Rome Lab prototype, iterative fabrication of devices, and evaluation.

PHASE II: Should involve development of actual pre-commercialization devices. Target commercial and DoD applications should drive device engineering. Packaging and cost issues should be fully addressed. Use of Photonics Center device design, evaluation, and fabrication resources, including access to the National Nanofabrication Facility, and research collaboration with Branch Personnel is encouraged in both phase I and II.

**DUAL USE COMMERCIALIZATION:** These devices have the potential to revolutionize both DoD fiber-optic communications and internetting systems, as well as the Nation's installed base of fiber-optic communications.

**REFERENCES:**

1. "A Laser Optical Amplifier with an Integrated Spontaneous Emission Filter", M. Parker et al, NASA Laser Tech Briefs, Vol. 2, No. 4, Fall 1994, in print.
2. Surveillance & Photonics Directorate WWW Home Page, via URL, "<http://www.rl.af.mil:8008/>

**TOPIC:** OSD95-021    **TITLE:** Optical Pattern Recognition for Validation and Security Verification

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**TECHNOLOGY:** Lasers, Optics & Power Systems, Human-Systems Interfaces

**OBJECTIVE:** In recent years, crime problems such as counterfeiting of currency and credit cards has increased to alarming proportions. Counterfeit parts such as computer chips and machine tools are arriving in America in great numbers. With the rapid advances in computers, CCD technology, image processing hardware and software, printers, scanners, and copiers, it is becoming increasingly simple to reproduce pictures, logos, symbols, money bills or patterns. This has stimulated an interest in research, development, and publications in security technology. In the growing area of biometrics identification, optical techniques are being used in developing products for retinal

scanning, hand geometry, vein recognition, and fingerprint identification. In the military realm, access to secure areas and sensitive information through passes or ID's is an important application. The means currently used to secure things, such as holograms on credit cards, and PIN numbers on a magnetic strip on credit cards, are today easily read by scanners, CCD cameras, etc.

**DESCRIPTION:** If the information were encoded in the form of optical phase it would be very difficult to read by ordinary means. This is because all physical detectors are only sensitive to the intensity of the read-out light. The phase information is lost in the process of going from complex amplitude to intensity. However, optical correlators are sensitive to this information, and can make binary decision based on this phase information on whether the information card or pass is valid and whether the person using the card is the rightful user. The same technique could be used to irretrievably attach a phase mask to a computer chip. Several techniques have been proposed to use this fact that the phase information is invisible to standard detectors in an encryption scheme that is virtually impossible to copy or counterfeit (ref 1.2).

**PHASE I:** Develop a feasibility study and a preliminary design and demonstration plan for phase II.

**PHASE II:** Develop, build, and test a brass-board model of an optical security system embodying phase-encoding as the encryption means in conjunction with some form of biometrics measurements.

**DUAL USE COMMERCIALIZATION POTENTIAL:** The commercial market is desperately in need of a simple, inexpensive scheme to stem the \$2 billion fraud rampant in this sector. In addition, there are ample military uses in entry into secure or sensitive areas, and the verification of parts, such as computer chips purchased by the government. It is very likely that phase-encoded encryption schemes could solve both these problems.

**REFERENCES:**

1. B. Javidi, J.L. Horner, J.F. Walkup, OPTICS & PHOTONICS NEWS, Sept. 94, pp. 13-19.
2. B. Miller, IEEE Spectrum, February 1993.
3. J. Horner, B. Javidi, J. Walkup, Patent Pending, "Optical Pattern System For Verifying The Authenticity Of A Person, Product, Or Thing," Docket #21069, filed 9/14/93.

**TOPIC:** OSD95-022    **TITLE:** High-Speed Electronic Imaging and Storage

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**TECHNOLOGY:** Electronics, Optics

**OBJECTIVES:** Investigate state-of-the-art developments in high-speed electronic imaging.

**DESCRIPTION:** The Wright Laboratory, Armament Directorate has been a leader in the development of applications for electronic imaging instrumentation technology. One of the highest requirements for the weapons research, development and test communities is a high resolution replacement for high speed film cameras. The key elements are the image sensor (million pixels, 1000 plus frames per second), the signal processor (gigaword per second, 8 to 12 bits per sample) and data storage (1000 to 10000 megawords in 1 cubic foot or less). We are currently developing a solid state image sensor for this process and have been performing research to address other areas. Numerous dual use applications are apparent. Among these applications are: automotive crash testing;

aircraft and engine testing; machine vision for manufacturing; web inspection (textiles, paper); rolled goods inspection (steel, aluminum); sports medicine and human performance monitoring. More important are applications where the high speed imager is the transducer input to another device combining technologies the Armament Directorate is investigating in optical computing, spectroscopy, and signal processing. Among these secondary applications are: optical compilers and correlators; medical radiology and diagnostics; optical storage and retrieval (holographic memory); optical spectrometers for process control and environmental monitoring, and illegal dump deletion; multispectral cameras for drug detection, crop and forest management, law enforcement, and treaty verification; DNA mapping and cell histology/cytology/pathology.

**PHASE I:** It is envisioned that Phase I will consist of analysis and design of a system using high speed imaging techniques from the sensor, signal processing, or recording areas. The design should have both commercial and military pay-off.

**PHASE II:** Phase II would consist of prototype fabrication and test. A commercialization plan is required for both Phase I and Phase II.

**DUAL-USE COMMERCIALIZATION:** Technology development in the high speed video area is key to all the desktop graphics input devices being developed. It is also key to the development of high resolution medical imaging devices such as MRI, CAT, and PET scanners. In addition, high speed imaging has application in automotive, commercial aircraft, and industrial testing.

#### **REFERENCES:**

1. McCurin, Schooley, and Sims, "Signal Processing for Low Light Level, High Precision CCD Imaging", SPIE Vol 1448, "Camera and Input Scanner Systems" (1991).

**TOPIC:** OSD95-023    **TITLE:** Multidisciplinary Design Optimization (MDO)

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**TECHNOLOGY:** Design Automation (computer aided design, concurrent engineering, simulation and modeling; including the computational aspects of fluid dynamics, electromagnetics, advanced structures, structural dynamics and other automated design processes).

**OBJECTIVE:** Develop Multidisciplinary optimization tools for the design of Airframe Structures with the emphasis on integration of structures, aerodynamics and controls disciplines.

**DESCRIPTION:** Airframe design optimization requires the integration of engineering disciplines: structures, aerodynamics and controls; mathematical disciplines: optimization, sensitivity analysis, implicit and explicit integration schemes; computer science related disciplines: executive and higher order languages, data bases and other software development issues. Over the last ten years the Flight Dynamics Directorate of Wright Laboratory has developed a prototype structural optimization system called "ASTROS" (Automated Structural Optimization System), and has publicized it through training workshops and distribution to industry, government laboratories and universities. ASTROS, at present, runs on most of the modern work stations (IBM RS6000, SGI, SUN, Hewlett-Packard, Dec Alpha, VAX, to name a few), and mainframes (CRAY-YMP-C90, Convex, etc.). Although "ASTROS" is a comprehensive self-contained structural optimization system, its architecture allows easy



enhancements and additions of new engineering modules. The latter feature of ASTROS offers great opportunities for small businesses to develop a secondary market through the development of enhancements as well as new modules to expand the scope of the multidisciplinary optimization system. Any expansion related to airframe and other aircraft subsystems optimization can be potential topic for the STTR solicitation. The following area is cited as an example for the expansion of MDO.

**Computational Fluid Dynamics:** The steady and unsteady aerodynamic modules of current MDO systems are based on panel methods because of their simplicity and versatility in handling the full range of flight conditions. Nevertheless, the general consensus is that these methods are inadequate to model the complex flight conditions of modern aircraft, including high-angle-of-attack, transonic and hypersonic ranges. The purpose of this solicitation is to investigate potential approaches for bringing the results of modern computational fluid dynamics research into the MDO environment. This is not intended for research in CFD per se but to devise schemes to factor CFD results into the design optimization environment.

**PHASE I:** Within the above area, develop requirements and criteria for establishing critical performance and operation bounds and identify the key parameters for optimization.

**PHASE II:** Utilizing the results of Phase I, develop efficient computational modules for integration into existing or future multidisciplinary optimization systems.

**DUAL-USE COMMERCIALIZATION:** Such an MDO system can be readily used for the design of all types of military and civilian aircraft, automobile and engine components, off shore platforms and other marine structures, and civil engineering structures such as buildings and bridges.

**REFERENCES:**

1. Johnson, E. H., and Venkayya, V. B., "Automated STRuctural Optimization System (ASTROS)," AFWAL-TR-88-3028, Volume I - Theoretical Manual, December 1988.
2. Neill, D. J., and Herendeen, D. L., "ASTROS Enhancements," WL-TR-93-3025, Volume I - ASTROS User's Manual, March 1993.

**TOPIC:** OSD95-024    **TITLE:** Multiple Degree of Freedom Measurement (MDFM) System

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**TECHNOLOGY:** Human-Systems Interfaces

**OBJECTIVE:** Investigate commercial applications of MFDM system in a commercial machine tool environment. The system has application as an accessory to coordinate measuring machines used in virtually every type of industrial setting.

**DESCRIPTION:** The MFDM program, ManTech contract F33615-89-C-5716, developed a laser-based system capable of measuring five geometric error components per axis simultaneously. The systems were found to have an accuracy of 1 micron for straightness measurement, and 0.5 arcsec for pitch and yaw measurement. The development work accomplished resulted in a prototype system demonstration at University of Michigan, the prime contractor. However, the original research focused solely on the system's potential use as a calibration device. No work has been accomplished to implement this system as a performance enhancer for coordinate measurement

machines (CMMs). Independent market analysis indicates a strong industry need for this type of device.

**PHASE I:** Further investigate the potential applications of the MFDM system. Develop preliminary design criteria to bring existing design prototypes to implement as appropriate, and develop and demonstrate commercial prototype.

**PHASE II:** Demonstrate updated prototype of the system for selected dual use technology areas. Implement beta sites to test the prototype, and document additional changes necessary to fully implement in a commercial setting.

**DUAL USE COMMERCIALIZATION:** The MFDM system has the potential for application in any industry area that uses a CMM - virtually every manufacturer in the world. This product could be a valuable tool for teaching factories and manufacturing extension centers as well.

**TOPIC:** OSD95-025    **TITLE:** Advanced Tooling Manufacture for Composite Structures (ATMCS)

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**TECHNOLOGY:** Human-Systems Interface

**OBJECTIVE:** Investigate applications of existing ATMCS expert system in other domains - metal forming, extruded plastic, etc.

**DESCRIPTION:** The ATMCS system, developed under ManTech contract F33615-89-C-5715, is an expert system that automates and greatly reduces the time required to design the tooling required to manufacture composite structures. The results show a 95% reduction in time, and the potential for cost savings using this system are enormous for the aircraft industry. The development work accomplished resulted in an implemented system at Northrop Aircraft, the prime contractor, and at several beta sites within the composites supplier subtier.

**PHASE I:** Investigate the potential commercial applications of ATMCS. Develop preliminary design criteria for additional knowledge bases, identify relevant parameters, and begin development of necessary additions to existing software.

**PHASE II:** Develop a prototype of the system for selected dual use technology areas. Implement beta sites to test the prototype, and document additional changes necessary to fully implement in a commercial setting.

**DUAL-USE COMMERCIALIZATION:** The ATMCS system has the potential for application in other industries that require tooling design. Some examples include metal forming, extrusion, and plastics molding. It could have use in any number of commercial manufacturing enterprises. The existing software shell would require tailoring, and a new knowledge base would need to be developed listing and relating the key parameters for each new technology area. This product could be a valuable tool for teaching factories and manufacturing extension centers as well.

**TOPIC: OSD95-026    TITLE: Intelligent Machining Workstation (IMW)**

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**TECHNOLOGY:** Human-Systems Interfaces

**OBJECTIVE:** Investigate military and commercial applications of IMW process planning and execution system in a modular machine tool environment. The system has application in such areas as metal cutting, concurrent engineering design, aerospace, automotive, telecommunications, industrial machinery, and machine tools.

**DESCRIPTION:** The IMW program, ManTech contract F33615-86-C-5038, developed a prototype set of software modules and novel tooling designed to perform unattended metal cutting planning and execution. The results showed use of this system resulted in a more efficient operation. This modular system can be used in total, or tailored to fit the needs of any size manufacturer. The development work accomplished resulted in a prototype system demonstration at Cincinnati Milacron, the prime contractor. No commercial activity was ever pursued after contract completion.

**PHASE I:** Investigate the potential commercial applications of IMW products. Develop preliminary design criteria to bring prototypes to current state of the art, upgrade existing prototype, and conduct market analysis to determine appropriate commercial areas and changes needed to existing product.

**PHASE II:** Demonstrate update prototype of the system for selected dual use technology areas. Implement beta sites to test the prototype, and document additional changes necessary to fully implement in a commercial setting.

**DUAL-USE COMMERCIALIZATION:** The IMW system has the potential for application in any industry area that uses machine tooling. Some examples include such areas as metal cutting, concurrent engineering design, aerospace, automotive, telecommunications, industrial machinery, and machine tools. The software and hardware could be offered as a package or as modular units, and could be used in any size manufacturer, from large primes to small manufacturing enterprises. This product could be a valuable tool for teaching factories and manufacturing extension centers as well.

**TOPIC: OSD95-027    TITLE: Measurement Techniques for Surfaces under Dynamic Contact**

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**TECHNOLOGY:** Interfacial Sensors, Data Retrieval

**OBJECTIVE:** Measure tire footprint slip velocities (relative to ground) and contact stress/pressures of tires rolling on a dynamometer or over a flat, paved track under steady-state or transient conditions. A measurement system

designed for dynamometer installation shall not adversely affect the structural integrity of the dynamometer. Tires will be subjected to a wide range of loading conditions, including, but not limited to, braking (ABS (automatic braking system) or steady) and cornering (transient or steady).

**DESCRIPTION:** Measurement system shall be applicable to both automotive and aircraft tires for input into durability and safety design improvement studies. Wear and handling characteristics, which are directly related to tire footprint quantities, change significantly as speed increases. Sensor technology state of the art (pin sensors) currently are capable of measuring pressure and slip in the contact region at low tire speeds (0.06 mph). Pin slip sensor technology, in its infancy, has already shown some limitations for low speed applications, but no promise for high speed applications. Pin pressure sensor technology (which is somewhat more developed) performance will be degraded in high speed dynamometer applications, due to vibrations and centrifugal effects.

**PHASE I:** Develop design and determine feasibility of:

- 1) slip sensor for low speed dynamometer and flat track use
- 2) contact stress and slip sensor types for high speed dynamometer and flat track use

**PHASE II:** Develop and deliver full scale final product. Install, test and validate on a WL/FIVMA dynamometer.

**DUAL-USE COMMERCIALIZATION:** The measuring system has commercial application to both the aircraft and automotive tire industries, as well as the military aircraft and automotive tire industries.

**REFERENCES:**

1. "The Tire-Pavement Interface", ASTM STP 929, edited by Pottinger & Yager, 1986.
2. "Mechanics of Pneumatic Tires", DOT HS 805 952, edited by Samuel Clark, 1981.

## **9.0 SUBMISSION FORMS AND CERTIFICATIONS**

Section 9.0 contains:

**Appendix A: Proposal Cover Sheet**

An original red-printed Appendix A must be included with each proposal submitted.

**Appendix B: Project Summary Form**

An original red-printed Appendix B must be included with each proposal submitted. Don't include proprietary or classified information in the project summary form.

**Appendix C: Cost Proposal Outline**

A cost proposal following the format in Appendix C must be included with each proposal submitted.

**Reference A: Proposal Receipt Notification Form**

**Reference B: DTIC Information Request Form**

**Reference C: Directory of Small Business Specialists**

**Reference D: SF 298 Report Documentation Page**

**Reference E: DoD SBIR/STTR Mailing List Form**

U.S. DEPARTMENT OF DEFENSE  
**SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM**  
**PROPOSAL COVER SHEET**

Failure to use a RED Copy as the original for each proposal and to fill  
in all appropriate spaces may cause your proposal to be disqualified

TOPIC NUMBER: \_\_\_\_\_

PROPOSAL TITLE: \_\_\_\_\_

FIRM NAME: \_\_\_\_\_

MAIL ADDRESS: \_\_\_\_\_

CITY: \_\_\_\_\_ STATE: \_\_\_\_\_ ZIP: \_\_\_\_\_

PROPOSED COST: \_\_\_\_\_ PHASE I OR II: \_\_\_\_\_ PROPOSED DURATION: \_\_\_\_\_  
PROPOSAL IN MONTHS

**BUSINESS CERTIFICATION:**

- |  | YES                      | NO                       |
|--|--------------------------|--------------------------|
| ▶ Are you a small business as described in paragraph 2.2?  | <input type="checkbox"/> | <input type="checkbox"/> |
| ▶ Are you a minority or small disadvantaged business as defined in paragraph 2.3?<br>(Collected for statistical purposes only)   | <input type="checkbox"/> | <input type="checkbox"/> |
| ▶ Are you a woman-owned small business as described in paragraph 2.4?<br>(Collected for statistical purposes only)   | <input type="checkbox"/> | <input type="checkbox"/> |
| ▶ Has this proposal been submitted to other US government agencies, or DoD components or other<br>SBIR Activity? If yes, list the name(s) of the agency, DoD component or other SBIR office<br>and Topic Number in the spaces below. | <input type="checkbox"/> | <input type="checkbox"/> |

▶ Number of employees including all affiliates (average for preceding 12 months): \_\_\_\_\_

PROJECT MANAGER/PRINCIPAL INVESTIGATOR

CORPORATE OFFICIAL (BUSINESS)

NAME: \_\_\_\_\_ NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_ TITLE: \_\_\_\_\_

TELEPHONE: \_\_\_\_\_ TELEPHONE: \_\_\_\_\_

For any purpose other than to evaluate the proposal, this data except Appendix A and B shall not be disclosed outside the Government and shall not be duplicated, used or disclosed in whole or in part, provided that if a contract is awarded to this proposer as a result of or in connection with the submission of this data, the Government shall have the right to duplicate, use or disclose the data to the extent provided in the funding agreement. This restriction does not limit the Government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained on the pages of the proposal listed on the line below.

PROPRIETARY INFORMATION: \_\_\_\_\_

SIGNATURE OF PRINCIPAL INVESTIGATOR \_\_\_\_\_ DATE \_\_\_\_\_ SIGNATURE OF CORPORATE BUSINESS OFFICIAL \_\_\_\_\_ DATE \_\_\_\_\_

INSTRUCTIONS FOR COMPLETING APPENDIX A  
AND APPENDIX B

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Courier 71 10 pitch  
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Additional red forms may be obtained from your State SBIR Organization (Reference D) or:

Defense Technical Information Center  
ATTN: DTIC-SBIR  
Building 5, Cameron Station  
Alexandria, VA 22304-6145  
(800) 363-7247 (800 DOD-SBIR)  
(703) 274-6902 (Commercial)

## U.S. DEPARTMENT OF DEFENSE

**SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM  
PROPOSAL COVER SHEET**

Failure to use a RED Copy as the original for each proposal and to fill  
in all appropriate spaces may cause your proposal to be disqualified

TOPIC NUMBER: \_\_\_\_\_

PROPOSAL TITLE: \_\_\_\_\_

FIRM NAME: \_\_\_\_\_

PHASE I or II PROPOSAL: \_\_\_\_\_

Technical Abstract (Limit your abstract to 200 words with no classified or proprietary information/data.)

Anticipated Benefits/Potential Commercial Applications of the Research or Development.

List a maximum of 8 Key Words that describe the Project.

_____	_____
_____	_____
_____	_____
_____	_____



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## U.S. DEPARTMENT OF DEFENSE

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U.S. DEPARTMENT OF DEFENSE  
**SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM**  
**COST PROPOSAL**

**Background:**

The following items, as appropriate, should be included in proposals responsive to the DoD Solicitation Brochure.

**Cost Breakdown Items** (in this order, as appropriate):

1. Name of offeror
2. Home office address
3. Location where work will be performed
4. Title of proposed effort
5. Topic number and topic title from DoD Solicitation Brochure
6. Total dollar amount of the proposal
7. Direct material costs
  - a. Purchased parts (dollars)
  - b. Subcontracted items (dollars)
  - c. Other
    - (1) Raw material (dollars)
    - (2) Your standard commercial items (dollars)
    - (3) Interdivisional transfers (at other than cost dollars)
  - d. Total direct material (dollars)
8. Material overhead (rate \_\_\_\_\_ %) x total direct material = dollars
9. Direct labor (specify)
  - a. Type of labor, estimated hours, rate per hour and dollar cost for each type
  - b. Total estimated direct labor (dollars)
10. Labor overhead
  - a. Identify overhead rate, the hour base and dollar cost
  - b. Total estimated labor overhead (dollars)
11. Special testing (include field work at government installations)
  - a. Provide dollar cost for each item of special testing
  - b. Estimated total special testing (dollars)
12. Special equipment
  - a. If direct charge, specify each item and cost of each
  - b. Estimated total special equipment (dollars)
13. Travel (if direct charge)
  - a. Transportation (detailed breakdown and dollars)
  - b. Per diem or subsistence (details and dollars)
  - c. Estimated total travel (dollars)
14. Consultants
  - a. Identify each, with purpose, and dollar rates
  - b. Total estimated consultants costs (dollars)
15. Other direct costs (specify)
  - a. Total estimated direct cost and overhead (dollars)
16. General and administrative expense
  - a. Percentage rate applied
  - b. Total estimated cost of G&A expense (dollars)
17. Royalties (specify)
  - a. Estimated cost (dollars)
18. Fee or profit (dollars)
19. Total estimate cost and fee or profit (dollars)
20. The cost breakdown portion of a proposal must be signed by a responsible official, and the person signing must have typed name and title and date of signature must be indicated.
21. On the following items offeror must provide a yes or no answer to each question.
  - a. Has any executive agency of the United State Government performed any review of your accounts or records in connection with any other government prime contract or subcontract within the past twelve months? If yes, provide the name and address of the reviewing office, name of the individual and telephone extension.
  - b. Will you require the use of any government property in the performance of this proposal? If yes, identify.
  - c. Do you require government contract financing to perform this proposed contract? If yes, then specify type as advanced payments or progress payments.
22. Type of contract proposed, either cost-plus-fixed-fee or firm-fixed price.

TO: \_\_\_\_\_  
Fill in firm's name and mailing address

SUBJECT: SBIR Solicitation No. 95.2  
Topic No. \_\_\_\_\_  
Fill in Topic No.

This is to notify you that your proposal in response to the subject solicitation and topic number has been received by

\_\_\_\_\_  
Fill in name of organization to which you will send your proposal.

\_\_\_\_\_  
Signature by receiving organization

\_\_\_\_\_  
Date

To: SBIR Participants

SMALL BUSINESS INNOVATION RESEARCH PROGRAM REQUEST FOR DTIC SERVICES

For assistance in the preparation of informed proposals addressing the topics presented in the DoD SBIR Program Solicitation, you are encouraged to request annotated bibliographies of technical reports from the Defense Technical Information Center (DTIC). The cited reports cover selected prior DoD-funded work in related areas. Reasonable numbers of these reports may be obtained at no cost from DTIC under the SBIR Program. You will also receive information on related work-in-progress, and references to other information resources.

Complete the request form, fold, stamp and mail. Please bear in mind that significant mailing delays can occur, please order early.

DTIC authorization to provide this service expires April 14, 1995, the DoD SBIR Program Solicitation No. 95.2 closing date.

REQUESTER \_\_\_\_\_  
Name

ORGANIZATION NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_  
Street

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_ PHONE \_\_\_\_\_  
Area Code/Number

Send technical reports bibliographies on the following SBIR topics:

TOPIC NUMBER	TOPIC NUMBER		TOPIC NUMBER	TOPIC NUMBER
1 _____	6 _____		11 _____	16 _____
2 _____	7 _____	<i>PLEASE TYPE OR PRINT IN THE ORDER TOPICS APPEAR IN THE SOLICITATION</i>	12 _____	17 _____
3 _____	8 _____		13 _____	18 _____
4 _____	9 _____		14 _____	19 _____
5 _____	10 _____		15 _____	20 _____

Company Status: I confirm that the business identified above meets the SBIR qualification criteria presented in Section 2.2 of the DoD Program Solicitation.

This is our first request during the current solicitation: yes \_\_\_\_ no \_\_\_\_.

\_\_\_\_\_  
Signature of Requester



=====FOLD HERE=====

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Return Address

\_\_\_\_\_  
STAMP  
\_\_\_\_\_

Defense Technical Information Center  
Building 5, ATTN: SBIR  
Cameron Station  
Alexandria, VA 22304-6145

=====FOLD HERE=====

Associate Directors of Small Business assigned at Defense Contract Management Districts (DCMD) and Defense Contract Management Area Operations (DCMAO):

**DCMD WEST**

ATTN: Renee Deavens  
222 N. Sepulveda Blvd., Suite 1107  
El Segundo, CA 90245-4394  
(800) 233-6521 (Toll Free CA Only)  
(800) 624-7372 (Toll Free-AK,HI,ID,MT,NV,OR,WA)  
(310) 335-3260  
(310) 335-4443 (FAX)

DCMAO San Francisco  
ATTN: Robert Lane  
1265 Borregas Ave.  
Sunnyvale, CA 94089  
(408) 541-7041/7042

DCMAO San Diego  
ATTN: Marvie Bowlin  
7675 Dagget Street, Suite 200  
San Diego, CA 92111-2241  
(619) 637-4922

DCMAO El Segundo  
ATTN: Debbie Tatum  
222 N. Sepulveda Boulevard, Suite 404  
El Segundo, CA 90245-4320  
(310) 335-3511/3495

DCMAO Seattle  
ATTN: Alice Toms  
3009 112th Ave., NE, Suite 200  
Bellvue, WA 98004-8019  
(206) 889-7317/7318

DCMAO Santa Ana  
ATTN: Laura Robello  
34 Civic Center Plaza, PO Box C-12700  
Santa Ana, CA 92172-2700  
(714) 836-2913 (ext. 659 or 661)

DCMAO Van Nuys  
ATTN: Diane Thompson  
6230 Van Nuys Boulevard  
Van Nuys, CA 91401-2713  
(818) 904-6158

DCMAO St. Louis  
ATTN: William Wilkins  
1222 Spruce Street  
St. Louis, MO 63103-2811  
(314) 331-5392 (ext. 231 or 229)

DCMAO Phoenix  
ATTN: Clarence Fouse  
The Monroe School Building  
215 N. 7th Street  
Phoenix, AZ 85034-1012  
(602) 379-6177

DCMAO Chicago  
ATTN: James Kleckner  
O'Hare International Airport  
10601 W. Higgins Road, PO Box 66911  
Chicago, IL 60666-0911  
(312) 825-6021

DCMAO Denver  
ATTN: Robert Sever  
Orchard Place 2, Suite 200  
5975 Greenwood Plaza Blvd.  
Englewood, CO 80110-4715  
(303) 843-4381

DCMAO Milwaukee  
ATTN: Paul Roppuld  
Henry S. Ruess Federal Plaza  
310 West Wisconsin Avenue  
Milwaukee, WI 53203-2216  
(414) 297-4328

DCMAO Twin Cities  
ATTN: Otto Murry  
3001 Metro Drive, Suite 200  
Bloomington, MN 55425-1573  
(612) 335-2003

DCMAO Wichita  
ATTN: George Luckman  
U.S. Courthouse Suite D-34  
401 N. Market Street  
Wichita, KS 67202-2095  
(316) 269-7137

**DCMD NORTHEAST**

**ATTN: John McDonough**  
495 Summer Street, 8th Floor  
Boston, MA 02210-2184  
(800) 348-1011 (Toll Free MA Only)  
(800) 321-1861 (Toll Free Outside MA)  
(617) 451-4317/4318  
(617) 451-3174 (FAX)

**DCMAO Boston**  
ATTN: Ann Howell  
495 Summer Street  
Boston, MA 02210-2184  
(617) 451-4108/4109/4110

**DCMAO Cleveland**  
ATTN: Herman Peaks  
1240 East 9th Street  
Cleveland, OH 44199-2064  
(216) 522-5446

**DCMAO Dayton**  
ATTN: Betty Adams  
c/o Defense Electronics Supply Center  
Building 1, 1507 Wilmington Pike  
Dayton, OH 45444-5300  
(513) 296-5150

**DCMAO Detroit**  
ATTN: David Boyd  
905 McNamara Federal Bldg, 477 Michigan Ave.  
Detroit, MI 48226-2506  
(313) 226-5180

**DCMAO Garden City**  
ATTN: Eileen Kelly  
605 Stewart Avenue  
Garden City, NY 11530-4761  
(516) 228-5724

**DCMAO Grand Rapids**  
ATTN: Kay Hamilton  
678 Front Street, NW  
Grand Rapids, MI 49504-5352  
(616) 456-2620

**DCMAO Hartford**  
ATTN: Frank Prater  
130 Darlin Street  
E. Hartford, CT 06108-3234  
(203) 291-7706/7705

**DCMAO Indianapolis**  
ATTN: Robert Staton  
Building 1  
Fort Benjamin Harrison, IN 46249-5701  
(317) 542-2015

**DCMAO New York**  
ATTN: John Castellane  
201 Varick Street, Room 1061  
New York, NY 10014-4811  
(212) 337-0326

**DCMAO Philadelphia**  
ATTN: Julia Graciano  
2800 S. 20th Street, PO Box 7699  
Philadelphia, PA 19101-7478  
(215) 737-5818

**DCMAO Pittsburg**  
ATTN: Rich Spanard  
1000 Liberty Avenue  
Pittsburgh, PA 15222-4190  
(412) 644-5926

**DCMAO Reading**  
ATTN: Thomas Knudsen  
45 South Front Street  
Reading, PA 19602-1094  
(215) 320-5012

**DCMAO Springfield**  
ATTN: Sylvia Liggins  
955 South Springfield Ave.  
Springfield, NJ 07081-3170  
(201) 564-8204

**DCMAO Stratford**  
ATTN: Otis Wade  
550 Main Street  
Stratford, CT 06497-7574  
(203) 385-4413

**DCMAO Syracuse**  
ATTN: Ralph Vinciguerra  
615 Erie Boulevard, West  
Syracuse, NY 13204-2408  
(315) 423-5664

**DCMD SOUTH**

ATTN: Howard Head, Jr.  
805 Walker Street  
Marietta, GA 30060-2789  
(800) 551-7801 (Toll Free-GA)  
(800) 331-6415 (Nationwide)  
(404) 590-6196  
(404) 590-2612 (FAX)

**DCMAO Atlanta**

ATTN: Sandra Scanlon  
805 Walker Street  
Marietta, GA 30060-2789  
(404) 590-6197  
(404) 590-2110 (FAX)

**DCMAO Baltimore**

ATTN: Gregory W. Prouty  
200 Towsontown Blvd.  
Towson, MD 21204-5299  
(410) 339-4809  
(410) 339-4990 (FAX)

**DCMAO Birmingham**

ATTN: Lola Alexander  
2121 Eight Avenue, N., Suite 104  
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